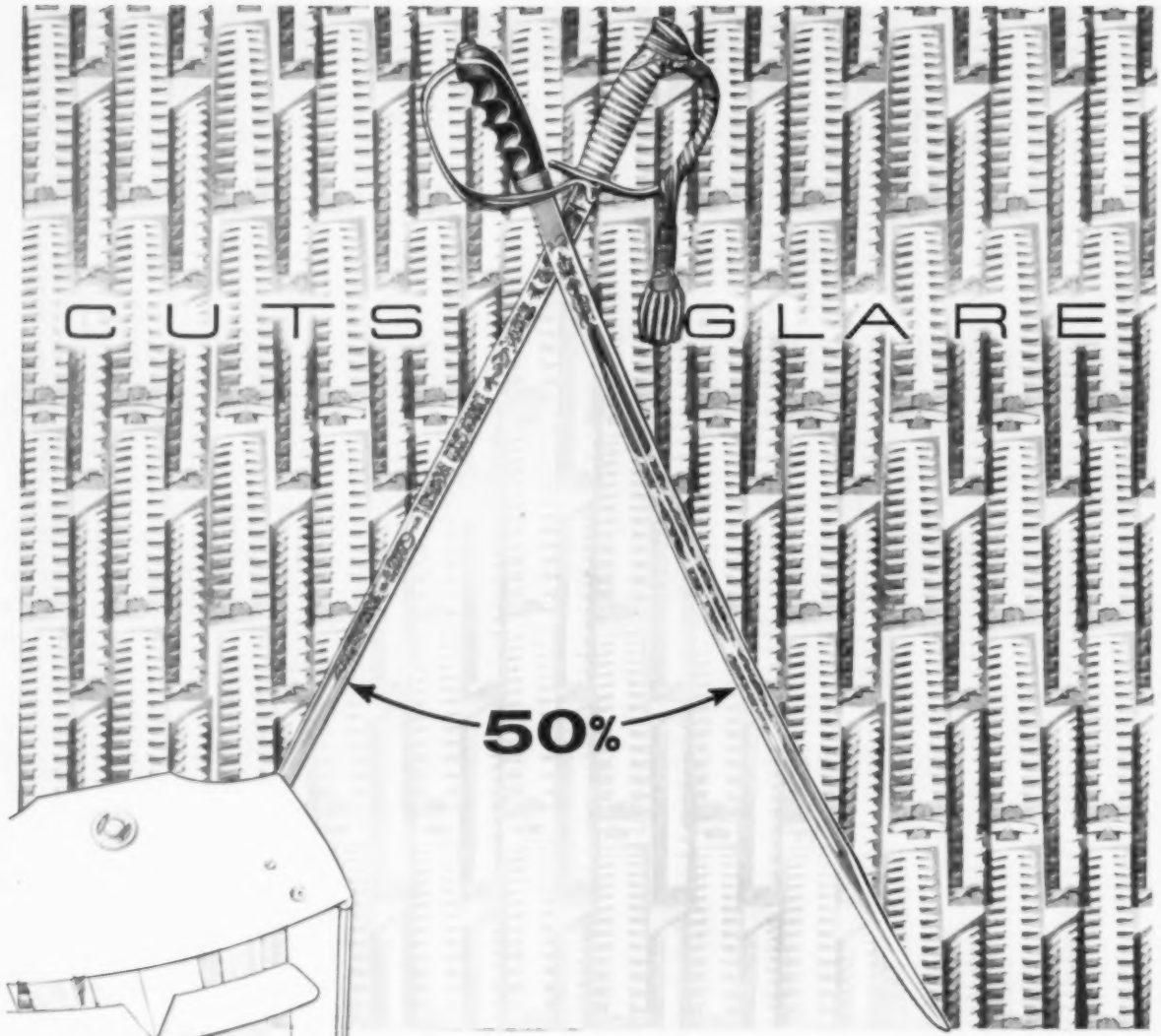
# ILLUMINATING ENGINEERING

MAY 1956

Calculating Coefficients of Utilization
Street Lighting and Street Trees
Design Procedure for Luminous Ceilings
and Lighting Applications

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY




**BENJAMIN VARSITY CUTS GLARE** with advanced louver design, typical of Benjamin's glare-cutting technique.

## New Shielding Efficiency Increases Seeing Comfort in Classrooms

Light is a friend of learning; glare, one of its worst enemies. To *cut glare* means to minimize fatigue, distractions, and classroom disorder. It is an important assignment of modern lighting units, such as the Varsity, to CUT GLARE without cutting lighting efficiency. Benjamin's new, specially-designed *louvers* are meant to do just that. Varsity lighting units are scientifically designed to cut lamp glare more than 50%. Advanced shielding is typical of Benjamin's glare-cutting technique.

Every Benjamin school lighting unit is engineered to cut glare in its own way, to do its own job. Some do it with specially-designed louvers; some with reflector contour; some with lamp shields. For a complete showing of GLARE-CUTTING Benjamin school lighting units, send for FREE folder AD-6549. Write Benjamin Electric Mfg. Co., Des Plaines, Illinois.

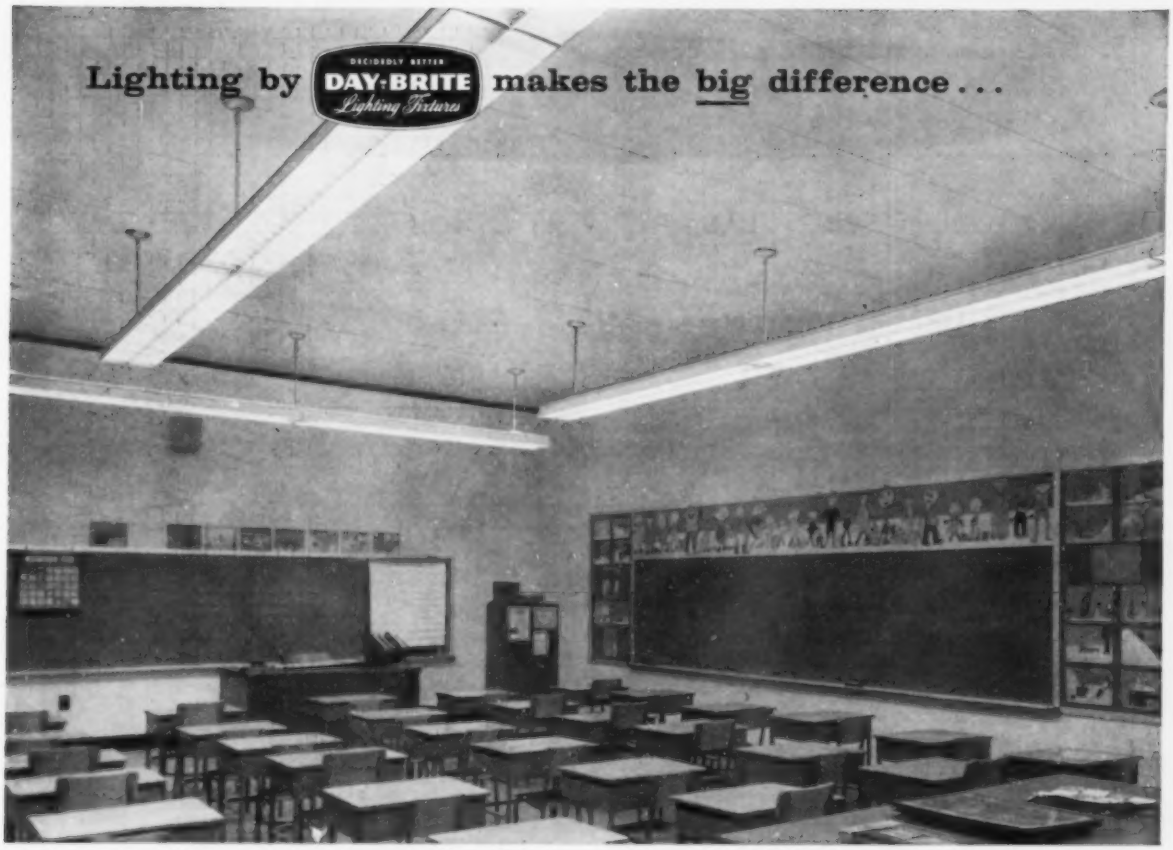
Certified Lighting

SUSTAINING MEMBER

**BENJAMIN**
LIGHTING EQUIPMENT

SOLD EXCLUSIVELY THROUGH ELECTRICAL DISTRIBUTORS

B-11038




Typical classroom, Jeffery Public School, Pittsburgh, Pa. Trefry Engineering, Designers and Engineers; Walter Electric Co., Electrical Contractors.

# For tomorrow's citizens... Day-Brite lights the way

Education has advanced far beyond the "3-R's" stage. So has school lighting by Day-Brite—as is fully evident from the photographs shown here.

The Jeffery Public School, at Pittsburgh, is another of many examples of how the famous Day-Brite LUVEX-U® is lighting the way for tomorrow's citizens. Note the uniform over-all illumination these fixtures provide—on desk tops, table tops, chalk boards. They assure comfort in seeing, relieve eye-strain and fatigue, do a full-time job of protecting students' priceless sight.

Before you decide on any phase of school lighting or relighting, consult your Day-Brite school-lighting representative. You'll find him in your classified phone directory. Or, send for school-lighting data.

View of board room, Jeffery Public School, Pittsburgh, Pa.

Day-Brite Lighting, Inc.
*5432 Bulwer Ave.*
*St. Louis 7, Missouri*
In Canada: *Amalgamated Electric Corp., Ltd.*
*Toronto 6, Ontario*

"DECIDEDLY BETTER" DAY-BRITE Lighting Fixtures

61129

**NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT**

# RS-240-SR

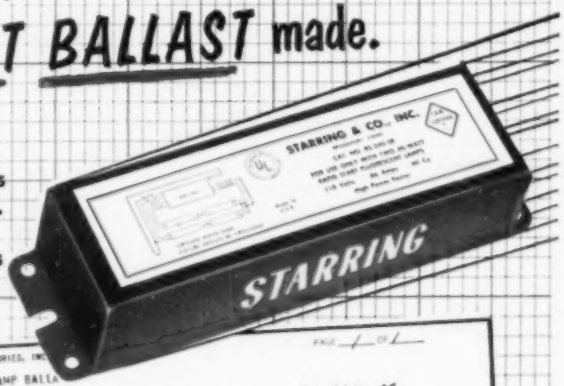
FURNISHED WITH 8 LEADS, ELIMINATING NECESSITY FOR JUMPER CONNECTIONS.

## ...this is, we believe, from every point of view the Finest *RAPID-START BALLAST* made.

**A high-power-factor Ballast for series operation of two 40-Watt Lamps on 118V-60C AC.**

**Like all Starring Ballasts**

***Engineered into Leadership!***



**RS-240-SR**

9½" x 2 13/16" x 2"
Mounting Length 8⅞"
Weight 4.8 pounds
Packed 10 per carton

**Check these ETL Data against Proposed ASA Specification C-82.1**

*... Ask for our Complete Catalog*

# STARRING & COMPANY, INC.

1600 SEAVIEW AVENUE • BRIDGEPORT 8, CONNECTICUT

EDison 4-0108

# ILLUMINATING ENGINEERING

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

May
1956

Vol. LI, No. 5



1955-1956 Officers

President
R. F. Hartenstein

Vice-President
M. N. Waterman

Vice-President
Kirk M. Reid

General Secretary
George J. Taylor

Treasurer
J. S. Schuchert

•

Editor
Ruby Redford

•

Advertising Manager
Clayton E. Ellis

•

Assistants
Barbara Lamson, Editorial
Adelaide Philiba, Advertising

•

Publications Committee
J. S. Schuchert, Chairman
Brooks Chassaing
H. F. Davidson
R. W. Morris
Aileen Page
J. A. Schneller

•

Executive Secretary
A. D. Hinckley

Technical Director
C. L. Crouch


## Contents


349 A Design Procedure for Luminous Ceiling Lighting — J. N. Robertson and G. E. Hutchcroft

357 I.E.S. Lighting Data Sheet — Series XXI
Lighting a Garage (10-28)

359 Report of Street, Tree and Utility Conference — Warren H. Edman

369 Fitting a Roadway Lighting Plan to Buildings, Trees and Grounds — David A. Toenjes

374 School Lighting System with a Single Source

375 Solving a Problem in a Press Room
Symmetry of Design in a Bank

376 Exterior Floodlighting
Quantity and Quality in Industrial Lighting

377 Development and Application of Quartz Infrared Lamps — Morgan Christensen and Alton G. Foote

383 I.E.S. Lighting Data Sheet — Series XXI
Lighting a Supermarket (12-98)

385 Calculating Coefficients of Utilization

8A TELECAST — Lighting News of Current Interest
Here and There with I.E.S. Members, 8A and 10A; Operation I.E.S., 20A; Lighting Calendar, 23A; About People, 28A; Obituaries, 31A; Books and Pamphlets, 31A; New Members, 40A.

21A I.E.S. National Technical Conference

53A Index to Advertisers

I.E.S. Committee Personnel — Latest listing appeared in the April 1956 issue of ILLUMINATING ENGINEERING

Sustaining Members — Latest listing appeared in the January 1956 issue of ILLUMINATING ENGINEERING



STATEMENTS and opinions in articles and papers in ILLUMINATING ENGINEERING are the expressions of contributors and do not necessarily represent the policies or opinions of the Society. Official Society opinions are expressed only in official committee reports specifically approved by the Council of the Illuminating Engineering Society.



ILLUMINATING ENGINEERING SOCIETY

EDITORIAL and advertising offices
1860 Broadway, New York 23, N. Y.

PUBLICATION office 32d Street & Elm Avenue, Baltimore 11, Md.

Founded 1906

*ILLUMINATING ENGINEERING:* The Journal of the Illuminating Engineering Society. Copyright 1956 by the Illuminating Engineering Society. Published monthly in the United States of America. Entered as second-class matter at the Post Office, Baltimore, Md. Acceptance for mailing at special postage rates provided for in Section 1103 P.L.&R., Act of October 3, 1917. Authorized July 16, 1918. ¶ Subscription $12 per year plus extra postage to all countries to which second-class postage rates do not apply; single copies $1.00. ¶ Address changes must be received at I.E.S headquarters by the first of the month to be effective with the issue of the next succeeding month.

## How to get the lens you need

When you want a lens to make light behave the way you want it to, we'd like to help you.

You can use our staff and research facilities to solve optical problems or to confirm your own findings.

You can use our production facilities to get the shape, size and configuration lens you need.

We've been helping people obtain specialized lightingware and mass producing lenses to close tolerances, economically for over 80 years.

**CORNING GLASS WORKS** 33-5 Crystal Street, Corning, New York

*Corning means research in Glass*

# it's BEAUTIFUL!
# it's GLAMOROUS!
# it's VERSATILE!

# it's *Edge-Glo* by CURTIS

**IT'S BEAUTIFUL:**

A spectacular glowing beauty that will enhance the appearance of any interior. The new Curtis Edge-Glo is long, thin (overall depth just 3½") with side panels softly illuminated by reflected light to give new modern ceiling construction an effect so startlingly beautiful that it offers unlimited design possibilities.

**IT'S GLAMOROUS:**

This glamorous luminaire brings startling effects to any new or existing decorative motif. It is sleek, streamlined, sparkling, the new Edge-Glo lends itself to dazzling effects that challenge even the most daring imagination. It may be close-ceiling mounted as a direct luminaire or pendant mounted for a 50-50 direct-indirect light distribution.

**IT'S VERSATILE:**

This new Curtis unit satisfies modern architectural design demands as well as high-quality illumination requirements. Unlimited designs may be achieved by mounting units individually, in patterns, or in continuous lines. Edge-Glo utilizes 2, 4 or 6 40-Watt, T12, 48" rapid start lamps. It is available with either rigid molded polystyrene plastic egg crate louver or Holophane No. 6016 plastic Controlens®. The new Curtis Edge-Glo is constructed of aluminum, Alzak processed after forming, or baked white Fluracite enamel.

For further details send the coupon today or contact the Curtis Lighting Specialist nearest you.

® Holophane Company, Inc.

**CURTIS LIGHTING, INC.**

**CURTIS LIGHTING, INC.**
6135 West 65th Street • Chicago 38, Illinois
In Canada: Curtis Lighting of Canada, Ltd.
195 Wickstead Ave., Leaside, Toronto 17, Ont., Canada

**SEND COUPON FOR COMPLETE INFORMATION**

**CURTIS LIGHTING, INC.**
6135 W. 65th Street, Chicago 38, Ill. Dept. 541-EG

Gentlemen:
Please send me further details on the new Curtis Edge-Glo luminaire.

NAME.....

ADDRESS.....

CITY..... STATE.....

# LITECONTROL makes Eyeing and Buying Easier in this Drug Store installation

This drug store (part of a large shopping center) is designed to take heavy traffic and the lighting in turn is designed to focus the traffic's attention on the merchandise with maximum eye appeal.

Litecontrol's new series 6000 fixtures which are approximately two feet by four feet were used. This size and type fixture provides a large area of low brightness and transmits a lot of light without specular glare or harmful shadows. Note the evenness of illumination. The fixtures shown were furnished with Albalite #66 glass, but are also available with Plexiglas dish diffusers.

Relamping and cleaning are easy. A light touch on the Trigger Catches opens fixture doors, and an easy push into place closes them securely. This type fixture is also available for Grid type ceilings, and for surface mounting, both two feet by four feet and two feet by two feet. Also comes with two, three or four lamps.

If you want to play up merchandise and play down glare — put it up to Litecontrol. Yes, and you'll find there's a *standard* Litecontrol fixture that will do a quality lighting job for every type of public building. May we help *you?*

INSTALLATION: Bause Super Drug Store, Allentown, Penna.

ARCHITECT-ENGINEER: Supowitz & Demchick, Philadelphia, Penna.

ELECTRICAL CONTRACTOR: The Howard P. Foley Co., Allentown, Penna.

DISTRIBUTOR: Graybar Electric Co., Inc., Allentown, Penna.

FIXTURES: Litecontrol No. 6034RS-66 3 Lamp 40 Watt Rapid Start, recessed fixtures with Corning Albalite #66 ribbed diffusing glass. No. 6000-27 Plaster Frames also furnished.

INTENSITY: Approximately 55 footcandles average in service. (Date of installation, December, 1954).

LITECONTROL *Fixtures*

KEEP UPKEEP DOWN

LITECONTROL CORPORATION

36 PLEASANT STREET, WATERTOWN 72, MASSACHUSETTS

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

# A Design Procedure for Luminous Ceiling Lighting

By J. N. ROBERTSON
G. E. HUTCHCROFT

WIDE ACCEPTANCE of luminous ceilings as a technique for interior lighting has created an immediate need for an accurate, reliable design procedure. Many illuminating engineers are experiencing difficulty in predicting results for luminous ceiling lighting. The basis of this difficulty appears to be uncertainty as to methods of calculation.

The second edition of the *IES Lighting Handbook* contains much useful information concerning luminous ceiling lighting. Sufficient data on the behavior of this type of lighting had not been assembled at the time this latest edition of the handbook was printed to allow an accurate and comprehensive method of calculation to be included.

The interreflection method appears to be the most satisfactory approach to the calculation of luminous ceiling lighting. Moon and Spencer[3] have contributed valuable development work to this method. Report No. 3 of the Committee on Standards of Quality and Quantity[6] contains additional application data. Neither of these sources, however, provides complete data and methods for direct, accurate design of luminous ceiling systems.

## Basic Design Requirements

Luminous ceiling lighting may be used occasionally for architectural or aesthetic effect. In these cases the seeing requirements are usually of secondary concern.

In a great majority of luminous ceiling applications, however, the seeing task is strenuous and good seeing conditions are essential. Basic requirements in the design of these lighting installations are to establish and control seeing conditions. Proper seeing conditions usually include all of the following elements:

1. Adequate brightness of the seeing task for desired visibility.
2. Sufficient illumination on the seeing task to produce adequate task brightness.
3. Low or controlled brightness ratio between the seeing task and its immediate background.
4. Controlled brightness ratio between the seeing task and its general background.
5. Controlled brightness variations throughout the lighted area.
6. Elimination or control of glare and specular reflections.

In designing a luminous ceiling installation that will fulfill these basic requirements for any desired relative visibility, it becomes necessary to calculate or predetermine the value of each of the following factors:

1. Brightness of the seeing task.
2. Illumination at the work plane.
3. Brightness of the ceiling.
4. Brightness of the walls.
5. Brightness of the floor.
6. Brightness of the furnishings.

## A Proven Design Procedure

A procedure that has been developed and used for designing a number of installations, with excellent results, is outlined below. Except for modifications which experience has proved to be necessary, this method follows the recognized procedures published in the *IES Lighting Handbook*.[1]

1. Use an appropriate form, similar to Table 9-7 shown on page 9-34 of the handbook,[1] for recording values.

2. Establish the average illumination that will be needed in the principal plane (a horizontal plane at one-quarter the height of the room) by the following means:

Investigate the specific application of the proposed design. Determine an adequate brightness for the principal seeing task that will provide the required visibility of the task. Compute the illumination required to produce this brightness by the following equation:

$$E_t = \frac{B_t}{r_t},$$

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 12-16, 1955, Cleveland, Ohio. AUTHORS: Department of Water and Power, City of Los Angeles, California.

in which

$E_t$ = illumination on the seeing task in footcandles.

$B_t$ = brightness of the seeing task in footlamberts.

$r_t$ = established reflectance of the seeing task.

If the seeing task lies in the principal plane,

$$E_{AV} = E_t,$$

where $E_{AV}$ = average illumination in the principal plane.

If the seeing task is not in the principal plane, $E_{AV}$ should then be calculated to provide the required value of $E_t$ for its correct position in the room.

3. Compute the room coefficient, using the following equation shown on page 9-33 of the handbook.[1]

$$\text{Room Coefficient} = \frac{\text{height} \times (\text{length} + \text{width})}{2 \times \text{length} \times \text{width}}$$

4. Compute the efficiency of the luminous ceiling system by means of the following equation:[5]

$$g = \frac{t\,(A_D + r_5 A_c)}{A\,(1 - r_2 r_5)},$$

in which

$g$ = efficiency of the ceiling system.

$t$ = incident transmittance of the translucent diffuser material.

$r_2$ = reflectance of the translucent diffuser material.

$r_5$ = reflectance of the cavity surfaces.

$A_D$ = area of the translucent diffuser.

$A_c$ = area of the cavity surfaces, including sides and all obstructions in the cavity.

$A = A_D + A_c$ = total area of the cavity surfaces and the diffuser.

5. Compute the initial average illumination at the work plane or, by transposition, find the number of lamp lumens required to provide any desired illumination by means of the following equation:[3]

$$E_{AV} = \frac{f g F_L}{L W},$$

in which

$E_{AV}$ = average illumination at the principal or work plane.

$f$ = interflectance of the room. Obtain from Table 5.03, page 198 of "Lighting Design" by Moon and Spencer.[3]

$g$ = efficiency of the luminous ceiling system.

$F_L$ = total initial lamp lumens = initial lumens per lamp × number of lamps.

$L W$ = area of the room (usually length × width).

If the lamp output is expressed in lumens and the room dimensions in feet, the illumination will be in footcandles.

6. Determine the average initial wall brightness by:

$$\text{Wall footlamberts} = E_{AV} \times A,$$

in which $A$ is obtained from Table 9-8A, page 9-35 of the handbook.[1]

7. Determine the average initial ceiling brightness by:

(a) At 45° to diffuser surface:

$$\text{Ceiling footlamberts} = E_{AV} \times B,$$

in which $B$ is obtained from Table 9-8B, page 9-36 of the handbook.[1]

(b) Normal to diffuser surface:

$$\text{Footlamberts} = \frac{g F_L}{A_D},$$

in which

$g$ = efficiency of the luminous ceiling system.

$F_L$ = total initial lamp lumens.

$A_D$ = total area of the luminous diffuser panels.

8. Determine the average initial floor brightness by:

$$\text{Floor footlamberts} = E_{AV} \times C,$$

in which $C$ is obtained from Table 9-8C, page 9-37 of the handbook.[1]

9. Determine the brightness of the furnishings and other significant surfaces by:

Footlamberts = footcandles striking surface × reflectance of surface.

10. Predict maintained or minimum future values by multiplying all initial values by an appropriate maintenance factor. It is suggested that both the initial and maintained predicted values be recorded and used in preparing the lighting design. The initial values form the base from which any future values of lighting may be predicted for various expected conditions of maintenance. The initial values also provide a means of comparing the design values against the actual lighting results on a new installation immediately after the completion of construction.

11. Proceed with general layout and details of design. The desired lighting results including intensity, brightness ratios, contrasts and other features may now be controlled through proper coordination between the illuminating engineer, the architect and the decorator.

**Use of the Method**

The procedure outlined above simply combines *IES Handbook* data with interflectance data of

Moon and Spencer, and introduces a realistic equation for finding the efficiency of luminous ceiling systems. Some points in the use of the method require discussion.

(a) *Ceiling Reflectance:* In any enclosure where the ceiling is luminous, or where luminous panels form the greatest portion of the ceiling area, the luminous ceiling becomes one of the major reflecting surfaces of the room. All tables referred to in this procedure require the ceiling reflectance to be used as one of the factors in selecting specific tabulated values. For this reason the effective reflectance of the ceiling as viewed from below must be determined.

The effective reflectance of a proposed luminous ceiling is difficult to determine accurately but it may be approximated by one of several methods. Three possibilities follow:

1. If the designer knows of an existing installation with identical diffuser material and with cavity proportions and paint similar to the contemplated design, the actual effective reflectance of the existing ceiling may be used as an approximation.

2. If samples of the diffuser material can be obtained, a small cavity may be constructed to the same proportion as that of the proposed job, painted with the same paint, and then the combined reflectance of diffuser and cavity measured. This will provide an approximation sufficiently accurate for practical application.

3. The authors have developed the following equation:[5]

$$R_2 = r_2 + \frac{t^2\left(\frac{A_C}{A}\right) r_5}{1 - \left(\frac{A_D}{A} r_2\right)\left(\frac{A_C}{A} r_5\right)},$$

in which

$R_2$ = effective reflectance of the ceiling as viewed from below.

$r_2$ = reflectance of the translucent diffuser material.

$t$ = incident transmittance of the translucent diffuser material.

$r_5$ = reflectance of the cavity surfaces.

$A_D$ = area of the translucent diffuser.

$A_C$ = area of the cavity surfaces, including sides and all obstructions in the cavity.

$A = A_D + A_C$ = total area of the cavity surfaces and the diffuser.

This equation has been used for several ceilings and has given calculated values very nearly equal to the measured reflectances. Its limitations are not yet known.

An equation for apparent theoretical reflectance is given on page 9-20 of the handbook.[1] That equation was obviously derived for an infinite ceiling. It has been the experience of the writers that this handbook equation provides a calculated value much too high to be used for the approximate reflectance of any actual luminous ceiling tested up to the present time.

(b) *Room Interflectance:* Table 5.03, page 198 of "Lighting Design" by Moon and Spencer,[3] is recommended as the source for obtaining the value of room interflectance with luminous ceiling lighting. While this recommendation is at variance with the intent of the authors of that book, it is based on experiences with actual installations. Data accumulated by the writers, from design practice, indicate strongly that values contained in Table 5.03 relate luminous ceiling lighting behavior almost perfectly.

Table 5.04, which the authors of "Lighting Design" provide for luminous panel lighting, appears to produce theoretical interflectance values much higher than are achieved in practice.

(c) *Ceiling System Efficiency:* In the foregoing equation for finding the average illumination at the work plane, the light output of the luminous ceiling appears as a product of two factors, ceiling system efficiency ($g$) and total lamp lumens ($F_L$). Since the light output of the ceiling depends on its efficiency, efficiency becomes one of the key factors which must be determined.

A number of items influence ceiling system efficiency. Since every square foot of surface area in the ceiling cavity obviously absorbs light, total cavity surface area and its reflectance are two of the important items. For this reason ceiling systems of otherwise identical design but installed in different structures may have widely different luminous efficiencies caused by variations in cavity surface areas.

The efficiency equation proposed herein is not rigorous, but does take into account cavity surface areas and is relatively simple to apply. This equation has been used for the design of a number of luminous ceiling installations and has been acceptably accurate with cavity surface area as great as four times that of the diffuser surface area. Its extreme limitations have not been determined. Present data indicate that it is not accurate for cavities so proportioned that the depth is greater than one-third the smallest dimension of the cavity opening.

In the use of this equation it is extremely important that the total area and location of all surfaces in the cavity be given consideration. The

equation does not fully account for all light losses that may be caused by interreflections between the surfaces of light entrapment spaces located within the cavity. A formula that would account for random entrapment losses would become too cumbersome for practical design use.

Light entrapment spaces in the cavity can be avoided, or held to a minimum by proper attention to the location of ventilation ducts, piping, boxes and such foreign objects as must sometimes be located in the cavity. Where entrapment spaces do occur their surface areas should be a very small percentage of the total cavity surface area. The effective light absorbing surface areas of such spaces can be estimated and added to the total cavity surface area in the equation. The resulting efficiency figure will usually be within desired limits of practical accuracy. If entrapment spaces are excessive, it may be necessary in some cases to consider all light entering them as being totally absorbed.

The effect of light absorption by the translucent diffuser material is accounted for in the efficiency equation. Diffuser materials available range from negligible to very high in light absorption characteristics. In the economics of selecting a diffuser material it is sometimes desirable to know the amount of light that would be absorbed by material under consideration for a particular application. The total absorption may be found by the following equation:[5]

The per cent of total lumens output of the source absorbed by the diffuser $= \dfrac{a(A_D + r_5 A_c)}{A(1 - r_2 r_5)} \times 100,$

in which $a$ = absorption factor of the translucent diffuser material. The other terms in the equation are the same as those in the efficiency equation.

An equation for luminous ceiling system efficiency is given on page 9-20 of the handbook.[1] That equation, however, is based on an infinite ceiling system where the surface area of the diffuser is equal to that of the cavity. It does not take into account the surface areas in the cavity. It is generally impractical to approach infinite ceiling conditions sufficiently close in commercial construction for the handbook equation to be of value.

(d) *Surface Brightness of Furnishings:* In some cases it is desirable to predetermine the surface brightness of furnishings and significant equipment in a room to a reasonably close accuracy. In these cases the use of average illumination in the principal plane to find surface brightness will give only an approximation for most objects within the room. The use of the "Shape Factor" method of geometry of transfer for calculating illumination and brightness of such surfaces provides more satisfactory results. This method may be obtained from a number of sources including Chapter 4 of Moon and Spencer[3] and Chapter 7 of Boast.[4]

## Results of This Practice

The writers have used the above procedures in the design of a number of luminous ceilings. Some of these have been installed and are now in service. A comparison of calculated design values with actual measured values in service for four of these installations[6] is shown in Table I. Table II shows comparative values for a luminous ceiling installa-

**TABLE I — Four Installations with Entire Ceiling Luminous.**

| | Installation "A" | | Installation "B" | | Installation "C" | | Installation "D" | |
|---|---|---|---|---|---|---|---|---|
| Item | Design Value | Average Reading | Design Value | Average Reading | Design Value | Average Reading | Design Value | Average Reading |
| footcandles ($E_{AV}$) | 113 | 111.2 | 107 | 107 | 82 | 84 | 47 | 45 |
| ft-L, walls | 52.8 | 54 | 45 | 49 | 58 | 60 | 19.4 | 18.4 |
| ft-L, window (night) | — | — | — | — | 11.9 | 12.3 | — | — |
| ft-L, @ 45°, ceiling | 150 | 150.1 | 148 | 149 | 141 | 138.8 | 137 | 135 |
| ft-L, @ 0°, ceiling | 173.5 | 173.8 | 168 | 170 | — | — | — | — |
| ft-L, floor | 37.2 | 40.3 | 26 | 25 | 25.5 | 27.2 | 3.3 | 3.7 |
| ft-L, desk top | 54.2 | 53.7 | 48 | 50 | 44.5 | 44 | — | — |
| ft-L, white paper on desk | 108.4 | 108.6 | 88 | 85 | — | — | — | — |
| ft-L, control bench | 39.6 | 38.9 | 37 | 32 | 28.6 | 31.6 | 16.5 | 18.2 |
| ft-L, inclined meter panels | 28 | 27.1 | 26 | 25 | 20.3 | 22.2 | 11.6 | 12.3 |
| ft-L, inclined meter faces | 68 | 70.5 | 53 | 51 | 40.6 | 42 | 26.6 | 29 |
| ft-L, vertical board panels | 19.7 | 19.2 | 16 | 15 | 14.6 | 13.4 | — | — |
| ft-L, vertical meter faces | 39.5 | 36.5 | 34 | 32 | — | — | — | — |
| Brightness ratio, task/background | 2.4:1 | 2.2:1 | 2.1:1 | 2:1 | 2:1 | 1.9:1 | 2.3:1 | 2.4:1 |
| Brightness ratio, max., in room | 7.6:1 | 7.8:1 | 11:1 | 10:1 | 12:1 | 11:1 | 42:1 | 37:1 |

**TABLE II — One Room with Seven Luminous Ceiling Strips, Each Having an Independent Cavity.**

| INSTALLATION "E" Item | Calculated Design Value | Average Field Reading |
|---|---|---|
| Footcandles ($E_{AV}$) | 116 | 113 |
| Walls, Footlamberts | 64 | 65 |
| Ceiling, luminous panels, Footlamberts at 45° | 313 | 303 |
| Ceiling, plastered area, Footlamberts at 45° | 40 | 38 |
| Ceiling average, Footlamberts at 45° | 104 | 100 |
| Floor, Footlamberts | 32 | 36 |

tion[6] which the writers did not design but one to which the procedure was applied. All values shown are initial values. These comparisons illustrate the accuracy of this design procedure.

## History of Development Work

About six years ago the authors became interested in the design of luminous ceiling lighting for certain types of illumination applications. Preliminary inquiries indicated that design data were quite meager. Considerable confusion seemed to exist among engineers regarding an approach to luminous ceiling design. Installations appeared to be made by hit-or-miss methods, with uncertainty as to results.

It quickly became evident that investigation and study would be necessary to obtain reliable design data. The study was begun.

Since there was no place for a full time research project in a busy production design office, pursuit of the study was slowly progressed at available odd moments during the ensuing years.

Complete physical design data, and all measured illumination and brightness values pertinent to the designs were obtained for seventeen different installations located throughout the United States.

Concurrently, a lighting test room was constructed for the purpose of testing results of the use of various diffuser materials, light sources, wall and floor colors, finishes and furnishings. Numerous different diffuser materials were installed and tested in this room with various combinations of lamp arrangements and different reflectances of cavity surfaces, walls and floor. Design calculations were carefully prepared for each combination and readings of actual light and brightness values were taken and tabulated.

For each commercial installation on which data had been obtained and for each combination arranged in the test room, two sets of design calculations were prepared. One set was calculated by the lumen method and tables contained in the *IES Lighting Handbook*. The other set was based on the interreflection method and tables contained in Report No. 3 of the Committee on Standards of Quality and Quantity.[2] After the second edition of the IES Handbook was published in 1952, the equation shown on page 9-20 for the efficiency of a luminous ceiling system was used to compute efficiency for the interreflection method of calculation.

In each case the calculated values were tabulated along with measured values for comparison. In all cases the calculated values failed to agree with measured values by amounts ranging from 15 per cent to over 50 per cent. As data were accumulated, it was noted that discrepancies between calculated and measured values followed patterns. These patterns appeared to be related to definite factors in the calculation procedures.

With the lumen method, errors in the calculated values were proved to have been caused by coefficients of utilization selected from Table 9-2 of the handbook.[1] The coefficients shown in this table were based on one set of arbitrarily selected average conditions, whereas the materials commercially available and being used had widely varying ranges of characteristics. It became evident that until Table 9-2 is extended to more nearly cover these ranges of characteristics, the lumen method as now provided in the handbook can be of only limited value for luminous ceiling design practice.

With the interreflection method of calculation there proved to be two principal sources of error. The source of greatest error was the value of ceiling efficiency when calculated by the handbook[1] equation. Variation patterns in the accumulated data indicated that in cases where all other factors were of the same order, the apparent magnitude of ceiling system efficiency bore an inverse relation to the total area of the cavity surfaces. From this concept an empirical formula for efficiency was worked out and used for a time. From this empirical formula the modified efficiency equation given in the procedure outline was developed analytically.[5] All basic factors that influence ceiling system efficiency were embodied in this modified equation.

The other source of error being introduced into the interreflection method was indicated by discrepancies in the value of luminous ceiling reflectance as viewed from below. In all cases, the calculated values computed by the reflectance equation given on page 9-20 of the handbook[1] were higher than the corresponding measured values. It was recognized that surface areas in the cavities were influencing the total effective reflectance as well as the efficiency of the ceilings. An equation for effective reflectance was then developed[5] from

the same basic concepts used in development of the modified efficiency equation.

Other steps listed in the design procedure developed as the most satisfactory results of experience.

### Necessity for Calculations

The apparent, current practice of overdesigning luminous ceilings to insure desired performance is economically unsound. It tends to restrict their use because of excessive costs. To make an efficient design and achieve expected results, it is necessary to calculate accurately basic design values. The large number of available materials with many combinations of variable characteristics make it impossible to select reliable, complete design values from any of the simplified tabulations now in popular use.

The procedure described herein provides a means of making simple design calculations and gives a logical, progressive order of work. Instead of being an academically pure procedure, this method includes the use of approximations for some minor factors. The results to date have been within the limits of accuracy of commercial instruments available for measuring light values.

Because the method is outlined in eleven steps, it may appear complicated and lengthy. One trial usage, however, will show it to be simple, direct and rapid. The authors are currently employing it, with complete satisfaction, for routine, commercial design work.


### Acknowledgments

Grateful thanks are extended to Mr. J. A. Williams formerly of Rohm and Haas Company and now of Electric Products Corporation; Dr. J. W. Richardson of Rohm and Haas Company; Mr. Wm. McGuire, representative of Wakefield Lighting Company; Mr. John D. Atkinson of Atkinson Enterprises. The cooperation of these men in supplying data and sample materials was of great assistance in the progress of this work.

Further gratitude is expressed to Mr. Calvin W. Rudolph of Philadelphia Electric Company for supplying complete technical data and reports on early luminous ceilings installed on properties of his company.

Apologies are offered to Professors Parry Moon and Domina Eberle Spencer for liberties taken with and references made to the use of their book "Lighting Design." Fundamental concepts contained in that book have proved sound and useful to the writers in their design work.


### References


1. *I.E.S. Lighting Handbook*, Second Edition, Illuminating Engineering Society, New York, 1952.
2. The Committee on Standards of Quality and Quantity for Interior Illumination of the Illuminating Engineering Society.
3. Moon, Parry, and Spencer, Domina Eberle: *Lighting Design*, Addison-Wesley Press, 1948.
4. Boast, W. B.: *Illumination Engineering*, McGraw-Hill Co., 1942.
5. The complete development of this equation is available in limited numbers from the authors.
6. Identification and data for instalations shown in the tables are available in limited numbers from the authors.


## DISCUSSION

DOMINA EBERLE SPENCER:* The authors are to be congratulated on their attitude toward lighting design, on their understanding of the factors involved in luminous ceiling lighting, and on the clarity and thoroughness of their design procedure. It is just such designs that should be made by all illuminating engineers.

The Robertson and Hutchcroft derivation of equations for $g$ and $\rho_2{}^*$ parallels the derivation[2] which is correct for an infinitely large shallow plenum ($k_r{}' = 0$). Two basic errors have been made: (a) It is assumed that the initial flux (pharos) on all interior surfaces of the plenum is uniform, and (b) it is assumed that the effect of subsequent interflections is exactly the same as when $k_r{}' = 0$.

While the first assumption may be a fair approximation in some cases, the second assumption is never valid for $k_r{}' \neq 0$. An algebraic solution is valid only for an infinitely large luminous ceiling; integral equations are unavoidable in the general case.

To obtain some notion of the accuracy of the proposed equations for $g$ and $\rho_2{}^*$, I have compared values calculated from them with values based on the correct equations[1] as as used in routine luminous ceiling calculations. For an unobstructed ceiling, the Robertson-Hutchcroft equation gives values which are consistently too high. Starting with a value of $g = 0.657$ for $k_r{}' = 0$, values of $g$ decrease as the plenum depth increases ($k_r{}'$ increases). However, the decrement is only about half of that obtained from the basic interflection equations.[1]

The Robertson-Hutchcroft equation for $\rho_2{}^*$ is an even poorer approximation than their equation for $g$ as it does not even reduce to the correct equation for $k_r = 0$. Preliminary calculations for obstructed luminous ceilings indicate that the Robertson-Hutchcroft formula for $g$ gives much higher values than are correct.

Apparently the authors have compensated for the inaccuracy of their equation for $g$ by also using the wrong values of $f$. As their values of $g$ are generally too high, they have arbitrarily employed values of $f$ from Table 5.03 of *Lighting Design* instead of those in Table 5.04. The combination has apparently given good values of the coefficient of utilization in a number of cases.

It is my hope that these able and industrious authors will procure a copy of "Interflections in Coupled Enclosures" and incorporate the correct equations for $g$ and $\rho_2{}^*$ into their excellent design procedure. A knowledge of integral equations is quite unnecessary for practical application of the results. Simple approximation can often be employed. For example, in the construction of a luminous ceiling slide rule, the varying logance of rooms employing a recommended plenum design was described by the simple equation:

$$g = 0.657\, e^{-0.1398\, k_r}$$


*University of Connecticut, Storrs, Conn.

As pointed out previously,[3] exponential approximations to interflection equations are often valid over the entire range from $k_r = 0$ to 1. These equations are not difficult to use and have been employed in practical work for the last five years. I hope that the next Conference will see another Robertson-Hutchcroft paper employing the basic method in a simple and beautiful fashion.

1. Moon, Parry, and Spencer, D. E.: "Interflections in Coupled Enclosures," *J. Franklin Institute*, 250, August 1950, p. 151.
2. Moon, Parry, and Spencer, D. E.: "Luminous Ceiling Lighting," ILLUMINATING ENGINEERING, Vol. XLIV, p. 465 (August 1949).
3. Moon, Parry, and Spencer, D. E.: "Simplified Interflection Calculations," *J. Franklin Institute*, 251, February, 1951, p. 215; "A Slide Rule for Lighting Calculations," *J. Optical Society of America*, 41, February 1951, p. 98.

ROBERT R. WYLIE:* The authors are to be congratulated for their efforts in beginning to analyze some of the "X" factors which have upset our engineering calculations in the application of luminous ceilings. It will be extremely gratifying when our calculations, recommendations and measurements under all conditions agree within 10 per cent at least 80 per cent of the time. Two points arise in reviewing this paper.

(1) Are the data given for ceilings which incorporate acoustical control? If acoustical control, in the form of baffles approximately 8 inches deep and regularly spaced on the plastic supporting members, say 3 feet on centers, are used what correction factor to the data given must be applied?

(2) Recognizing that perforated acoustical tile in the cavity may introduce an "X" factor into the cavity reflection estimate by reducing the apparent ceiling reflectance from 80 per cent (manufacturer's paint data) to an actual of 50 per cent or less, will the authors please suggest more specifically the form to be used for the estimating or calculation of the other serious entrapment factors — those of simply shaped duct-work, circular pipes, fixture shape and like obstructions.

JULIUS N. ROBERTSON and GLENN E. HUTCHCROFT:** Dr. Spencer has an intimate understanding of the behavior of luminous radiation. She has contributed immeasurably to the science of illumination by having resolved much of that behavior into fundamental analytical expression for engineering application. Since the described design procedure involves the use of interflectance, her comments are pertinent.

The authors, as with most other practicing design engineers, are forced by economic pressure to be more concerned with performance results of any procedure than with the pure academic aspects of development. There must be no quarrel, however, between pure theory and practical application. The lighting profession owes much to Spencer, Moon, Buckley and many others whose research and mathematical genius have provided tools for continuous progress. The responsibility for adapting, modifying and applying these tools to the art rests primarily with engineers working professionally in commercial practice and as Committees in the Illuminating Engineering Society.

The design procedure used by the authors is largely a composite of previously available information assembled in progressive steps. These steps are independent of each other, and each may be used, altered or omitted to suit the requirements of the design under consideration. In the step for computing the efficiency of a luminous ceiling system, any efficiency formula that is correct for the ceiling system involved may be substituted and used for calculation.

A very high percentage of luminous ceiling applications have large, shallow cavities containing various extraneous surfaces. It is this most usual type of cavity on which the authors have concentrated their study and developed equations for efficiency and effective ceiling reflectance. For ease and simplicity of use, these equations were made algebraic in nature.

The efficiency equation provides a simplified solution that is a very close approximation, if its limitations are observed. For emphasis, those limitations are repeated:

(1) The equation will not be accurate for a cavity so proportioned that its depth is greater than approximately one third the smallest dimension of the cavity opening.

(2) Every square foot of every surface contained within the cavity must be included in the term $A_C$ of the equation.

(3) If excessive, unavoidable light entrapment spaces occur within a cavity, their total light absorption may be estimated. The efficiency as calculated by the equation should then be reduced by the effective amount of light absorption.

Dr. Spencer's criticisms of this equation are analytically correct. The objections she raises, however, are proving to have little practical consequence. Experience has shown emphatically that reasonably uniform light distribution must be obtained within the plenum. Non-uniformity can cause such drastic brightness variations of the diffuser that the desired effect of the luminous ceiling will be completely destroyed.

Where $k_r' \rightarrow 0$ within the first limitation imposed above, it appears that the principal losses are from absorption by surfaces within the cavity rather than from the effect of the shape of the cavity.

For these large shallow cavities the authors believe that Dr. Spencer's analysis setting a maximum value of $g = 0.657$ should have further study. Efficiencies determined by taking candlepower distribution in all directions on completed ceilings indicate that this value is being exceeded on many ceiling systems.

Deep or peculiarly shaped cavities are unusual in practice and become cases requiring special consideration. For these the integral equation for the general case proposed by Dr. Spencer[1] may be used. This equation was appended by Jeavons, Horner and Burnham[2] in ILLUMINATING ENGINEERING.

Caution, however, must be exercised in the application of the Moon and Spencer equation for the general case to any specific luminous ceiling plenum. That equation does not account for the effect of the position and area of extraneous surfaces that appear in many cavities. In the special case where the cavity is very clean, as where continuous reflector pans are installed, it should be quite accurate. Many engineers, however, may find that equation very tedious to solve.

The authors concede to Dr. Spencer that their algebraic equation for effective ceiling reflectance does not reduce to a correct integral form for any condition of $k_r'$. Up to the present time, however, the reflectances of many ceilings have been computed by this equation, and subsequently measured in service. In no instance has the measured value differed from the calculated value by more than five per cent. The authors plan to continue its use until a more accurate equation of comparable simplicity appears.

The use of lower interflectance values from Table 5.03

*Commercial Engineer, Sylvania Electric Products, Inc., Salem, Mass.
**Authors.

of *Lighting Design* instead of those in Table 5.04 is an arbitrary practical adaptation. This adaptation is not related to the problem of ceiling efficiency.

It is believed that the accuracy of the interflectance tables has been acceptably established. The values of $f$, however, relate the relative amounts of light that reach the ceiling, walls and floor in a bare room without furnishings. The authors are concerned with the ultimate lighting conditions in fully furnished and equipped rooms, and believe a consideration of bare rooms only to be misleading. The introduction of furnishings and equipment into a room partly disrupts the bare room interreflections. This results in a lowered effective room interflectance. The amount of lowering depends on the size, amount, arrangement and color of the furnishings.

The lower values of Table 5.03 are used to compensate for the lowering of room interflectance caused by furnishings. Experience with luminous ceilings has shown this to be a fair compensation for average conditions where furnishings are light colored and not extreme in amount or size. For extreme conditions, other considerations should be made.

The authors appreciate the discussion by Mr. Wylie. The points he raises are quite pertinent. Much is yet to be learned regarding the influence of these "X" factors in the application of luminous ceilings. The writers have no specific answers to the questions asked by Mr. Wylie, and can only offer further discussion of these same points.

(1) The predominant data accumulated are from installations where acoustical treatment has been applied to surfaces in the room below the luminous ceiling diffuser. The writers have not had sufficient experience with acoustical members incorporated into the ceiling system to formulate correction factors for these members.

It is hoped that others with wider experience in the use of acoustical baffles have recorded data, and will offer helpful suggestions in this area.

(2) The authors have been unable to formulate an accurate analytical method of calculating the effect of serious entrapment factors within the cavity. Three principal things have been done to keep entrapment spaces at a minimum, and to estimate the effect of extraneous surfaces within the cavity.

(a) Design for high efficiency. Two important points in this are to avoid serious entrapment spaces and to paint all surfaces in the cavity with high reflectance paint. It has been found that many entrapment spaces can be eliminated by the careful placing of foreign objects in the cavity. This has frequently been accomplished by a close coordination with structural engineers, air-conditioning people and plumbers. A high, diffuse luminous reflectance of above 90 per cent on all surfaces has been found quite feasible with commercially available paints. This has been achieved by the illuminating engineer's insistence on control of painting specifications for the cavity.

(b) Estimate the effect of light absorption by surfaces within the cavity. This has been done by calculating the total area of the developed surface of every duct, pipe, fixture channel, structural member, box and similar object in the cavity. The total area of these surfaces is then added to the area of the side walls and top of the cavity in the term $A_C$ of the efficiency equation.

(c) Consider the effect of serious entrapment spaces. In cases where deep entrapment spaces unavoidably occur within a cavity consider all light entering them as being totally lost. For example assume a ventilation duct being installed near a structural member, leaving a deep narrow space between them. The number of lumens entering this space may be estimated from the area of the opening. The number of lumens entering such an entrapment space should be subtracted from the total lumens output $F_L$ of the lamps because all but a negligible amount of the light entering will be absorbed within the space.

1. Moon, Parry, and Spencer, D. E.: "Interflections in Coupled Enclosures," *J. Franklin Institute*, 250, August 1950, p. 151.
2. Jeavons, R. T., Horner, R. H., and Burnham, R. D.: "Cavity Efficiency for Translucent Ceilings," ILLUMINATING ENGINEERING, Vol. L, No. 3, p. 137 (March 1955).

## I.E.S. Emblem — Available during Anniversary Year For Use by Sustaining Members

During this 50th Anniversary year, Sustaining Members of the Society have been granted the privilege of using the I.E.S. Emblem in their advertising. A special insignia utilizing this symbol of the Society has been designed for this purpose; with reproduction proofs available from the Publications Office of I.E.S.

This privilege, which has never before been extended, will be in effect for Sustaining Members only during the entire year of 1956.

INSTALLATION AT QUEBEDEAUX CHEVROLET, 750 WEST POLK ST., PHOENIX, ARIZ.

# Lighting a Garage

**LIGHTING OBJECTIVE:** To provide adequate illumination in a garage repair and service area.

**GENERAL INFORMATION:** Precision motor work is done in the repair and service area shown above. The automobiles are parked perpendicular to the wall so that the individual luminaires light the engines from either side. No bulky work such as body and fender repair is done in this part of the garage. This area measures approximately 115 feet by 30 feet, ceiling height is 14 feet. Surface characteristics are as follows:

| | | |
|---|---|---|
| ceiling | white | 80% RF |
| walls | | |
| upper | light buff | 50% RF |
| lower | turquoise | 20% RF |
| equipment and cabinets | | |
| along wall | white | 87% RF |
| in pit | chrome plated | 87% RF |
| wheel balancing unit | red | 25% RF |

(over)

A.I.A. File No. 31

Figure 2.

**INSTALLATION:** Eighteen Grayco Catalog No. SB-296 and three Grayco Catalog No. SGL-296 luminaires are suspended 5 feet overall and located as shown in Fig. 2. Each luminaire is equipped with two 96-inch T-12 standard cool white slimline fluorescent lamps. The continuous row of luminaires in the repair area is controlled by one switch and the other pendant luminaires are individually controlled by pull chains. The single pendant luminaire over the pit is positioned so that the light falls on the equipment and also down along both sides of car wheels. One Kirlin Company Catalog No. 1212 unit equipped with a 12½-inch heat-resisting wide spread lens and a 300-watt PS-30 inside frosted general service lamp is recessed in the wall of the pit. Three swivel spotlights (Amplex Corporation Catalog No. C11SH), each equipped with one 150-watt PAR-38 spot lamp, are located at one end of the repair and service area as shown in Fig. 2. These spotlights are used to highlight a car which is displayed there.

Average general illumination measured 42 footcandles, with local area lighting ranging above 50 footcandles. Brightnesses are as follows:

| | |
|---|---|
| pendant luminaires (No. SB-296) | |
| crosswise at 45° | 1250. ft-L |
| crosswise at 30° | 1250. ft-L |
| lengthwise at 30° | 1250. ft-L |
| outside of housing at 45° | 1.5 ft-L |
| ceiling | 3. ft-L |
| walls | |
| upper | 4.8 ft-L |
| lower | 2.5 ft-L |
| cabinets along wall | 13.9 ft-L |
| top of work bench | 9. ft-L |
| wheel balancing unit | 2.5 ft-L |

**Lighting designed by Frank M. Gasperak, Commercial & Industrial Department, Arizona Public Service Co., P.O. Box 2591, Phoenix, Ariz., and installed by Deberge Electric Co., 550 West Washington St., Phoenix, Ariz.**

**Lighting data submitted by Frank M. Gasperak, Arizona Public Service Co., as an illustration of good lighting practice and to aid in the design of similar installations.**

**Published by the Committee on Publications of the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.**

# Report of Street, Tree and Utility Conference

By WARREN H. EDMAN

THREE HUNDRED Arborists, Street Lighting Engineers, and Utility Authorities met last March in Cleveland, Ohio, to study their common problem of how to coexist on a narrow strip of public property and best perform their respective services in the public interest. This was the first meeting of its kind jointly sponsored by the Illuminating Engineering Society, National Shade Tree Conference, and the Edison Electric Institute.

The first part of this paper briefly summarizes the highlights believed to be of general interest and pertinent to a better understanding of the functions performed by street lighting, street trees, electric and telephone services.

The second part reports in detail new information on permissible departures in street lighting design together with additional data developed since the conference.

## Part I — Conference Highlights

The opening theme of the conference was the "why aspect" of street lighting, overhead wires, and the cultural, aesthetic and historic background of tree use along the street sides. The second theme was the "how aspect" of proper design of street lighting, overhead power and telephone lines, and selection of trees to minimize the public area conflict.

The closing theme was the "coordination aspect" among the three groups which was demonstrated by examples that through understanding of one another's problems and the desire to cooperate — all interests, both public and private, could be best served.

The result of two days in conference indicated remarkable agreement as to the objectives and means of their achievement. All of the speakers, well known in their respective fields, showed general recognition of the overall problem as they presented papers which were basically concerned with their own specialized field. Traditional conflicts among street trees, street lights, and overhead wires, should no longer continue to be accepted as an unsolvable problem. The enthusiastic and sincere desire for mutual cooperation left little doubt as to the future progress of a program keyed to public acceptance.

### Street Tree Aspects

Mr. Charles Young, City Forester, Baltimore, Maryland, stressed that street trees perform functions favorably affecting the health and well being of the people and contributing to the aesthetic and cultural values of the community. Washington, D. C. was pointed out as an example of the importance of street trees, without which that city would not command world-wide esteem and recognition as a beautiful city. They are the dominating feature of the landscape. Shade trees are essential to the community for their contributions which cannot be duplicated or replaced by structures or other plants.

The "Selection in Use of Trees to Minimize Public Area Conflicts" was discussed by Mr. Edward Scanlon, Consulting Arborist and Editor of *Trees*, Cleveland, Ohio. He showed several excellent illustrations and examples of a number of streets where old conflicting trees had been removed and new "in scale" trees planted. The difference was quite revealing. The proceedings of this conference which will soon be available shows all of these illustrations. Also included is a comprehensive listing of recommended tailored trees for use along streets.

Mr. G. D. Blair, Forestry Consulting Services, Jackson, Michigan, called attention to the outmoded tree planter and line builder customs, habits and practices of the past which have parleyed over the years into serious present tree and wire conflict problems in many communities. Excessive annual tree control costs, severe service interruptions, and adequate overhead plant investment protection may reflect this problem in electric and telephone company operating records.

The City Forester of Toledo, Ohio, Mr. J. A. Sweeney, stated that large forest trees such as Soft Maples, Elms, Poplars, and Willows do not have room to grow in the curb area and are a community hazard with their dwarf root system. They are susceptible to storm damage and are much too costly to maintain and remove. He emphasized

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 12-16, 1955, Cleveland, Ohio. AUTHOR: Holophane Company, Inc., Newark, Ohio.

AN ANALYSIS OF FACTORS AFFECTING TREES AND SUPPLY LINES

| COMPONENT FACTORS / KIND OF SERVICE | QUALITY OF SERVICE is measured by | TYPE OF FACILITY INSTALLED which includes | MANNER OF INSTALLATION which requires | INVESTMENT IN FACILITIES which | COST TO THE RESIDENT is reflected in |
|---|---|---|---|---|---|
| ELECTRIC | Continuity of service and Capacity of facilities | Basic supply pattern and Mechanical strength | Clearance from trees and traffic | Tends to increase with greater clearances | Charge for service |
| STREET LIGHT | Continuity of service and Intensity of Illumination | Basic supply pattern and Mechanical strength | Clearance from trees and traffic | Tends to increase with greater clearances | Taxes levied |
| SHADE | Amount of shade (Beauty) | Size and shape and Location | Clearance from lines and traffic | Tends to decrease with lesser height | Investment made |

**Figure 1.**

that it is far cheaper to supply the proper trees tailored to accommodate electric services. The results of a program started in 1946 to plant tailored trees such as native Hawthornes and Flowering Crabs have been most successful. These trees do not interfere with electric lines or street lighting.

### Overhead Electric and Telephone Service Aspects

Mr. G. E. Dean, Public Service Electric and Gas, Newark, New Jersey, emphasized that overhead lines for electric power and street lighting service are the best engineering solution. The public streets are the best place for these services because here the construction costs are the lowest and street lighting can be supplied without duplication of pole lines.

The chart shown in Fig. 1 was prepared by Mr. E. V. Sayles, Consumers Power Company, Jackson, Michigan. He also presented the chart shown in Fig. 2 relating the effect of ground clearance to the cost of open wire line construction.

Mr. G. J. Vaupel, New Jersey Bell Telephone Company, pointed out that in 1934 a program was started to encourage trees to be set back ten to thirteen feet away from electric facilities. Through educational publications and working with public officials, tailored trees planted to fit the space available have demonstrated that no tree pruning will ever be necessary. These favorable results have given added encouragement to eventually obtain state ordinances to specify space requirements and types of trees to be planted.

Mr. R. Hicock, Connecticut Light and Power Company, Hartford, Connecticut, reported that a state-wide Shade Tree Committee was formed in 1952. It includes representatives of nurseries, women's clubs, colleges, city and state officials, electric utilities, and other interested organizations. This committee considers long range growth control, tailored trees, pest control, etc. It issues publications describing the best trees for use in Connecticut. Also, through trained personnel, contacts are made with real estate developers, and new home owners to assist in proper street tree planting programs.

Mr. H. T. Sealy, Cleveland Electric Illuminating Company, Cleveland, Ohio, explained a cooperative and coordinated program that is now under way in the Cleveland area. His company has employed a Consulting Arborist who works out master street tree plans for the towns they serve. Here is an example which offers a great deal to the community. Several communities have already adopted

OPEN WIRE SUPPLY LINES ON CITY STREETS
GROUND CLEARANCE VS LINE COST

| GROUND CLEARANCE PROVIDED (FEET) | RELATIVE COST OF SUPPLY LINES (PER CENT) | |
|---|---|---|
| | STRAIGHT STREETS | CURVED STREETS |
| 20 | 100 - 100 | 120 - 130 |
| 30 | 110 - 130 | 130 - 150 |
| 40 | 130 - 160 | 150 - 180 |
| 50 | 150 - 190 | 180 - 210 |
| 60 | 200 - 230 | 220 - 250 |

**Figure 2. It will be quite apparent that a chart such as this can, at best, be only approximate. Its sole purpose is to give a rough indication of the effect of ground clearance on the cost of open wire line construction.**

such plans with results demonstrating that the usual foliage conflicts can be eliminated.

**Street Lighting Aspects**

Mr. David Baldwin, National Safety Council, enumerated the many social and economic reasons for street lighting. He emphasized that accidents and congestion, two symptoms of a sick transportation system, are everywhere. The annual traffic fatalities are running between 35,000 to 40,000 with 60 per cent occurring at night. Added to this, the economic loss is estimated at over four billion dollars per year.

Visibility, fatigue, alcohol, and drivers are at least four factors which may account or help account for the difference between day and night accident rate. This rate continues to be three times more hazardous at night. One undeniable fact remains. While three of the four factors are difficult to change, the factor of visibility is one we can do something about. Vehicle headlighting is one method of attack. Modern street lighting is another and more effective method and its use is increasing at a rapid rate. Because the installation of street lighting offers a splendid chance for a "before" and "after" type of study, there have been many examples of the favorable effect of lighting on traffic accidents. Installations of modern street lighting have been followed by substantial reduction in death and injury. Comprehensive statistics showed that in Denver an 18 per cent reduction in night accidents followed the installation of improved lighting. Kansas City, Missouri, reported on 97 miles of streets the reduction to be 31 per cent in night injury accidents following the lighting improvement. Similar experiences are repeated all over the country.

In the Los Angeles, California area served by the Southern California Edison Company, the tremendous annual growth rate of new homes has developed a need for a program of education, planting, and supply of suitable street trees. Mr. R. E. Dahlin stated that through cooperation of tree experts and nursery men, suitable types of trees are now recommended and being made available for the five different climatic zones served by his company. Fifty thousand copies of their publication "Trees" will be mailed to new home owners in 1955. This program is expected to pay rewards to every one concerned with street lighting and electric service.

The Municipal Art Commission in Rochester, New York, passes on all items on the streets including street lights and street trees. Mr. F. J. Schmitt, of Rochester Gas and Electric Company, stated this city has an active program of tree planting, removal of old trees which interfere with utilities and street lighting, and a tree trimming program in accordance with the I.E.S. recommended practice. The results have demonstrated that conflicts with street lighting and overhead circuits can be effectively controlled.

Mr. D. A. Toenjes, General Electric Company, Cleveland, Ohio, presented an example of coordination in planning a new street lighting system along the streets and driveways at Nela Park. Certain sections were heavily forested which presented some unusual problems. A more comprehensive paper describing this new street lighting system will be presented in a separate paper.

Mr. H. W. Bassett, Town of Brookline, Massachusetts, presented an outstanding example of a coordinated program by the Utility, the Street Tree Planting Committee, and Street Lighting Engineers.

Brookline has had the benefit of a Tree Planting Committee with full powers of Tree Wardens since 1898. All streets are heavily forested with a variety of species. Since 1928 a plan of controlled height has led to selecting species accordingly on all streets with overhead power services. The commission also sponsored legislation to plant trees and maintain them on private property away from power lines and street lights.

A comprehensive plan for street lighting modernization was started in 1950. Existing luminaire heights were mostly 14 feet on short brackets as shown in Fig. 3. Adequate pruning was impractical and too costly, with the result that many of the streets were dangerously dark. A more prac-

**Figure 3. Low mounted old type open reflector luminaire on 4′ bracket.**

**Figure 4. New luminaires mounted out over street. (Same locations as Fig. 3.)**

tical solution was to use longer luminaire supports, up to 16 feet maximum length, at 25-foot mounting height. I.E.S. Type I light distribution pattern was decided upon between the local utility and the city. Such a typical luminaire arrangement is shown in Figs. 4 and 5.

Through cooperation and joint planning with the Tree Planting Committee a trial installation was made. With proper pruning it was demonstrated to this committee that actually only a few branches and twigs needed to be cut to avoid conflict with the light beams. The photograph in Fig. 5 shows the pruning line. As the program progressed it became noticeable how the daytime appearance of the streets improved in addition to more effective visibility at night. The photograph in Fig. 6 shows a typical night view using the I.E.S. Type I distribution suspended well out toward the center of the street.

**Figure 5 — Type I luminaires on long mast arm showing 75° vertical tree trimming line. Note old type gas lamps mounted along curb.**

The major portion of the program is now completed. The results here again confirm the fact that through the planned approach and cooperation of interested groups the results are mutually beneficial. The Brookline story can well be emulated by all municipalities throughout our country.

A joint paper "Design of Street Lighting — Standards and Permissible Departures" was presented by Mr. Henry Osborne of the City of Buffalo and myself. Mr. Osborne selected and explained those elements of the "American Standard Practice of Street and Highway Lighting" particularly appropriate to this conference group. He emphasized the pertinent information in the tables and charts contained in this publication which are used in standard street lighting system design.

My part of this joint paper dealt with permissible departures from standard street lighting design which allow for practical compromises with street trees.

### Part II — Street Lighting System Design

This second part reports in detail the new information not heretofore published. It also includes additional data developed since the conference which may be of assistance to those dealing with street lighting design on heavily forested streets.

### Special Foliage Considerations

It should be noted that even with high mounted luminaires it is not necessary to prune all trees to the height of the luminaire. It is necessary to prune only those branches which fall below the cone of maximum candlepower. Foliage midway between luminaires and somewhat below lamp level helps to screen distant sources; the attendant reduction in glare helps visibility and comfort of motorists and pedestrians. This gain is particularly important on local traffic and residential streets where limited funds usually require relatively long spacings, with correspondingly high candlepower at angles near the horizontal.

Another gain comes from reflection of upward light by the foliage downward to the street and sidewalk. Although the amount is small it significantly adds to the low levels of illumination on local traffic streets. Pruning for street lighting,

when properly done, is considered by arborists to enhance rather than detract from the appearance of the street as a whole. Also by day a street has a much more pleasing appearance if distant street luminaires, brackets, poles, and wires are screened by foliage. Fig. 7 illustrates the proper pruning for a typical lighting arrangement. Fig. 8 shows a tree pruning chart which was derived from the formula shown in Fig. 7.

### Design — Compromises

In order to minimize conflicts with trees there are certain compromises which can be made in the street lighting system. These compromises involve deviations from preferred system layout with respect to luminaire spacing, mounting height, and transverse location. Such deviations must usually be accompanied by modifications in the light distribution provided by the street lighting luminaire. The amount of reduction in lighting effectiveness will vary depending upon the circumstance, type of modification, and the extent of the deviation.

### Design — Modifications

As an example of modification, all luminaires may be mounted on longer mast arms. This generally increases construction costs to some extent, but the gain in lighting effectiveness may be substantial, if foliage interference is thereby reduced. Another modification is span-wire suspension of luminaires over the center of the street. Construction costs are substantially higher because two poles are required for each luminaire. A major disadvantage of span-wire suspension is that swaying and bobbing of luminaires in the wind nullifies to a great extent the effectiveness of the light control provided by modern luminaires.

Still another modification is that the mounting height can be reduced with a corresponding reduction in spacing, smaller lamp size, and lowering the angle of maximum candlepower. This method materially increases the cost of street lighting.

Only as a last resort, it might be expedient to increase lamp sizes to compensate for reduction in illumination levels caused by foliage interference. However, this has serious disadvantages because the impairment of light distribution and uniformity of illumination cannot be corrected by merely increasing lamp sizes. Also, the cost is increased considerably.

### Design — Departures

Where deviations in longitudinal spacing of luminaires are made to minimize conflicts with trees, generally a 10 per cent deviation from average spacing will not seriously affect the uniformity of illumination. As a maximum compromise for certain types of luminaires, deviations up to 20 per cent can be tolerated providing no two consecutive luminaire locations are involved. When two or more consecutive locations necessitate deviations from the average spacing, then the resulting uniformity of illumination should be checked against minimum requirements of "American Standard Practice for Street and Highway Lighting." It should also be kept in mind in working out design compromises to minimize tree conflicts, that substantial departures from uniformity of luminaire spacing detract from the appearance of the street. Fig. 9 shows results of 20 per cent deviation in spacing using modern reflector-refractor luminaires.

**Figure 6. Night view of new luminaires with I.E.S. Type I Distribution (same street as shown in Fig. 5).**

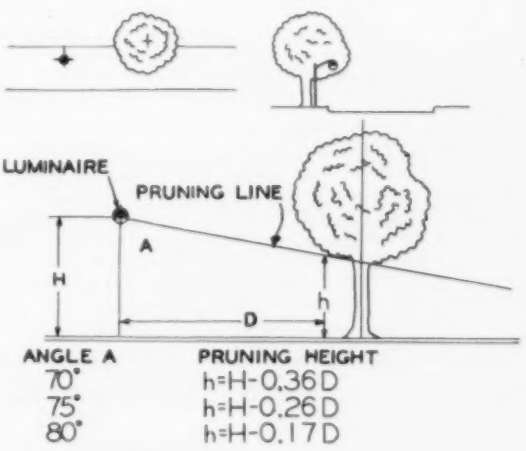



**Figure 7. Recommended tree pruning.**

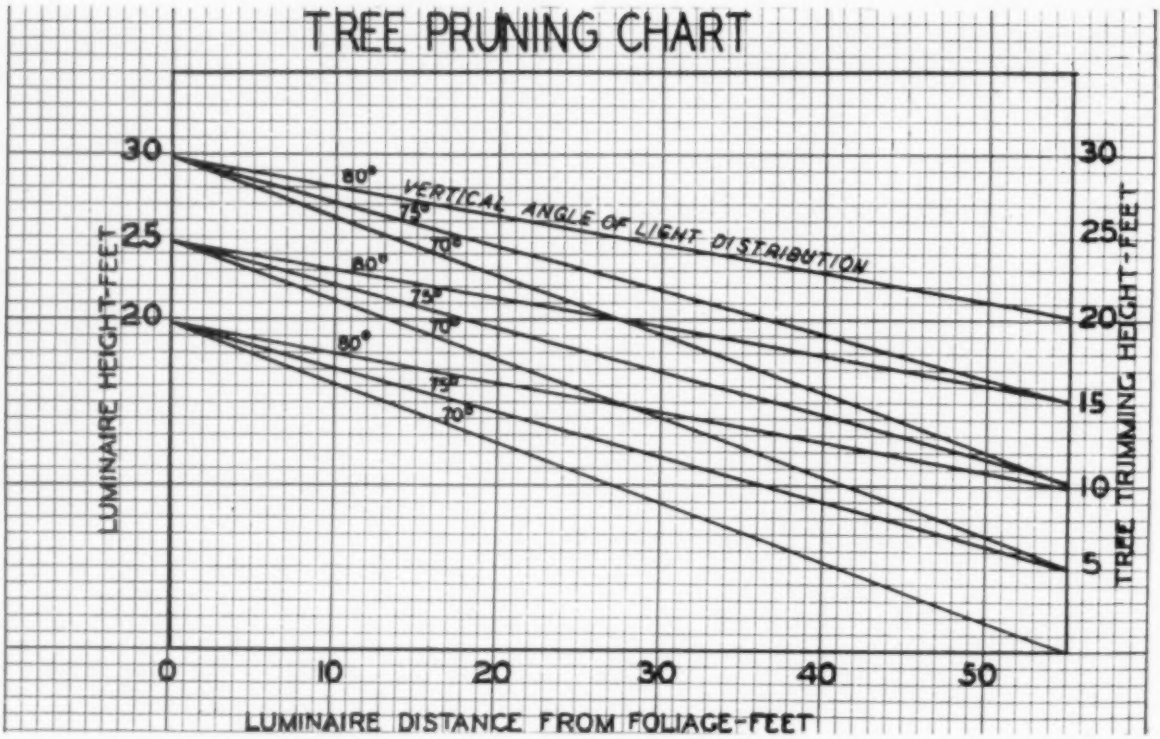



Figure 8. Tree Pruning Chart.

| | | UNIFORM SPACING | 20% DEVIATION |
|---|---|---|---|
| IES TYPE II ENCLOSED HIGH VERTICAL ANGLE LUMINAIRE<br>144′ 96′ 120′ 120′ 7′ OVERHANG 30′ 20% DEVIATION<br>25′ M.H. 2500 L. LAMP | Minimum Ft. C. | .065 | .049 |
| | Ave. Ft. C. | .20 | .20 |
| | Ratio Ave.:Min. | *3.08 : 1 | *4.08 : 1 |
| IES TYPE I ENCLOSED HIGH VERTICAL ANGLE LUMINAIRE<br>288′ 240′ 30′ 1.8′ 1.5′ 20% DEVIATION<br>25′ M.H. 6000 L. LAMP | Minimum Ft. C. | .080 | .044 |
| | Ave. Ft. C. | .258 | .258 |
| | Ratio Ave.:Min. | *3.23 : 1 | *5.90 : 1 |
| IES TYPE III ENCLOSED LUMINAIRE<br>144′ 96′ 120′ 120′ 40′ 20% DEVIATION 5′ OVERHANG<br>25′ M.H. 6000 L. LAMP | Minimum Ft. C. | .306 | .288 |
| | Ave. Ft. C. | .540 | .540 |
| | Ratio Ave.:Min. | 1.76 : 1 | 1.88 : 1 |

*IES permits maximum ratio of 10:1

Figure 9. Comparison of illumination data for uniform and 20 per cent deviation in luminaire spacing.

**TABLE I—Height to Foliage Interference for Different Types of Street Trees.**

| Transverse Distance from Curb in Feet | TYPES OF TREES | | | | |
|---|---|---|---|---|---|
| | Column Upright | Oval Upright | Globe-Head | Broad Pyramid | Narrow Pyramid |
| 4′ | 8′ | 9′ | 8′ | 8′ | 8′ |
| 6′ | 9′ | 11′ | 9′ | 9′ | 9′ |
| 8′ | 13′ | 15′ | 10′ | 10′ | 10′ |
| 10′ | * | * | 11′ | 12′ | * |
| 12′ | * | * | 14′ | * | * |
| 16′ | * | * | * | * | * |

*No foliage interference.

Uniformity of location of luminaires out over the street is important both as respects visibility and appearance. Only where there is no other reasonable compromise should any transverse deviation of an individual luminaire be permitted. The length of the luminaire support should be selected which best meets the requirement of each particular street. It should be kept in mind that when using longer supports which approach the center of the street, pruning requirements also approach the minimum.

### Design — Data

Table I, Fig. 10 and Fig. 11 are intended to serve as a guide for determining proper overhang distances of luminaires for different mounting heights and for different types of street trees. These along with Fig. 8 make it possible to determine the important dimensional relationship of street tree and street lighting design. For example from Fig. 10 and Table I, we note that with a 10-foot or longer luminaire overhang there will be no foliage interference from an oval upright type of tree. However, if an 8-foot overhang is selected, Table I shows that the height to foliage interference is 15 feet above the pavement. Refer to the chart in Fig. 8 and follow along the 15-foot "Tree Trimming Height Line" until it crosses the line representing the vertical angle of light distribution of the luminaire and its mounting height. For a 25-foot luminaire height and a 75-degree vertical angle of light distribution, the longitudinal luminaire distance from the foliage must be over 37½ feet in order to avoid all interference.

Although, foliage interference mostly affects the illumination on the street pavement, we must not overlook the importance of adequate lighting for the sidewalks. There may be instances on local traffic residential streets where it is even more important to assure good sidewalk illumination. Generally, this can be obtained either by altering the luminaire positions or by pruning, or a combination of both methods.

The modern trend in street lighting practice is to use larger light sources with luminaires having light distributions appropriate for the luminaire spacing, mounting height, and transverse positions, for the street dimensions. Such proper lighting design is particularly important on residential and local traffic thoroughfares. It should also be emphasized, where we see by silhouette discernment the high angle emission of light from the luminaire is very important. Obviously with longer spacings there are proportionately fewer luminaires which, in turn, reduces the requirements for pruning.

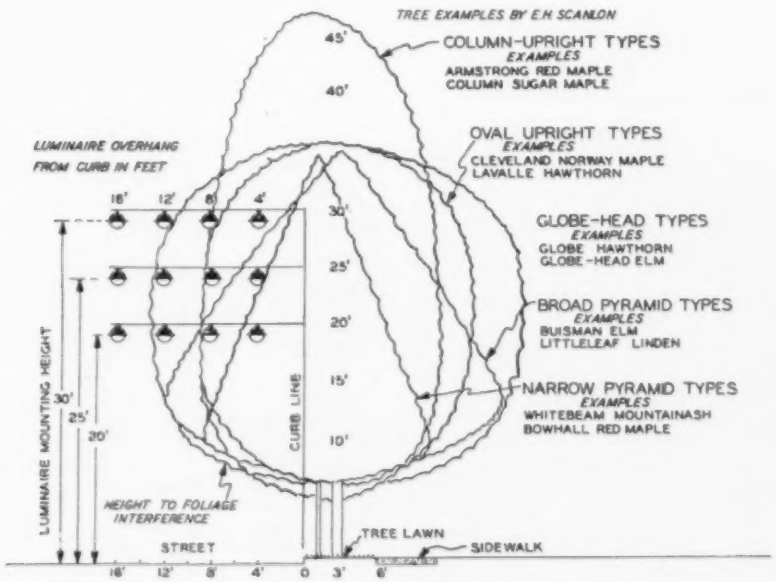



**Figure 10. Height to foliage interference for different types of street trees and luminaire overhang from curb.**

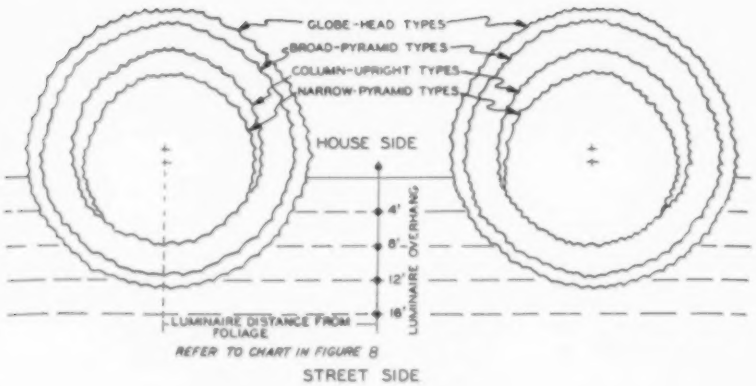



**Figure 11. Longitudinal and transverse location of luminaires as related to different types of street trees.**

This further contributes to lower combined maintenance cost of trees and street lighting. Observations in different sizes of towns with properly designed street lighting, indicate that as an average the number of actual conflicts between luminaires and foliage is in the order of 50 per cent on the more heavily wooded streets. It is quite probable that of the total existing residential and traffic street mileage, the foliage interference is considerably less than 50 per cent.

Progress and proper coordination have already been made in many instances. Our major problem is with existing streets where trees have been planted without the benefit of planning in relation to street lighting. The people responsible for street lighting and street trees must face the problem and be ready to cooperate and compromise, wherever compromises are necessary. With such an attitude by both groups, we can with minimum difficulty formulate recommendations which will provide several practical compromise methods, the choice of which should be left to each individual municipality.

### Pruning Costs

It would seem most desirable that a careful cost analysis be made whenever conflicts arise between street lighting and foliage interference. Accurate studies which have been made so far indicate that in most instances it would be far more economical to prune trees rather than to increase street lighting costs to compensate for the foliage interference with the lighting. Surely every progressive municipality wishes to fulfill its responsibility to provide effective safety lighting on its residential and traffic streets, together with providing maximum benefits from street trees. How can this be accomplished at lowest cost to the taxpayer? As an interesting comparison, costs have been estimated as shown in Table II for maintaining required street lighting performance based on tests reported by Reid and Scanlon in the April 1948 issue of ILLUMINATING ENGINEERING. Typical average street lighting costs per mile have been used for overhead wood pole construction. Due to the many variable components which enter into final street lighting costs, each locality will vary somewhat.

It is hoped that those more familiar with tree pruning practices can compare these added street lighting costs with pruning costs. The reduction in illumination caused by tree interference may seriously impair the effectiveness of the street lighting system. It is particularly important to avoid such impairment of lighting effectiveness because

**TABLE II — Cost of Street Illumination as Affected by Tree Pruning in Cleveland, Ohio.**

| | Average Street Lighting Evaluator Rating | Per Cent Decrease | Annual Street Lighting Cost per Mile | *Seasonal Cost of Tree Interference per Mile |
|---|---|---|---|---|
| **EAST 117TH STREET, PENDENT LUMINAIRES 4000 LUMENS 21 FT. MOUNTING, 25 FT. PAVEMENT, 300 FT. SPACING** | | | | |
| Winter before Pruning | 3.1 | 16 | $610.00 | $50.00 (6 mos.) |
| Summer before Pruning | 2.6 | 24.5 | 610.00 | 75.00 (6 mos.) |
| Summer after Pruning | 3.7 | ..... | 610.00 | — 0 — |
| **EAST 174TH STREET, PENDENT LUMINAIRES 6000 LUMENS 26 FT. MOUNTING, 28 FT. PAVEMENT, 290 FT. SPACING** | | | | |
| Winter before Pruning | 2.6 | 30 | $775.00 | $116.00 (6 mos.) |
| Summer before Pruning | 2.5 | 32 | 775.00 | 124.00 (6 mos.) |
| Summer after Pruning | 3.7 | ..... | 775.00 | — 0 — |

*Represents cost (add the two seasonal costs for total annual cost) of additional illumination necessary to compensate for loss of light due to tree interference, or conversely this represents dollar value of light salvaged by proper pruning. It is important to note that in both cases with proper pruning the illumination levels do not exceed minimum ASA Recommendations.

most lighting systems are designed to barely meet minimum ASA requirements for safety to both pedestrians and motorists.

It should be emphasized that the proportion of street lighting cost wasted by foliage interference will justify in whole or in major part the cost of proper pruning. The added benefits accruing to the street trees themselves and the improved appearance of well kept trees become a most worthwhile bonus to the taxpayer.

## Conclusions

I would like to commend the three co-chairmen of this conference — John W. Anderson, Edison Electric Institute; Edward H. Scanlon, National Shade Tree Conference; and Kirk Reid, Illuminating Engineering Society, for their contributions to the success of this first conference. It took eighteeen months of planning, arranging and hard work to bring it to realization. These three national organizations pooling their thoughts and interests for the common good, have created a healthy climate in which there now undoubtedly exists tolerance and respect. This, in turn, will result in continued harmony and efficiency in the planning and work which lie ahead.

### References


1. Proceedings of Street, Tree Utility Conference, March 1955, Wade Park Manor, Cleveland, Ohio.
2. "American Standard Practice for Street and Highway Lighting," February 27, 1953, Illuminating Engineering Society, New York, New York.
3. Reid, Kirk M., and Scanlon, Edward H.: "Correlation of Street Lighting and Street Tree Management," ILLUMINATING ENGINEERING (April 1948).


## DISCUSSION

C. A. B. HALVORSON:* In regard to shade trees and their relation to street lighting, readers of Mr. Edman's present report may be interested in details of an early study in this connection. Prior to 1940 the Selectmen of the town of Brookline, Mass., long famous for its shade trees, voted to make a comprehensive traffic accident survey of their town. This was undertaken, in great detail, by the Commonwealth of Massachusetts Highway Department under the direction

*Lighting Consultant, East Lynn, Mass.

**Figure A. (above) Typical residential street, heavily foliaged, with lamp post, 12-foot bracket and luminaire giving IES Type I distribution (4000 lumens).**

**Figure B. (left) Illumination results obtained with the installation shown in Fig. A. A minimum in tree pruning was required.**

**Figure C. (below) This shows location of the luminaire surrounded and shielded by the foliage (luminaire in circle). Boston Edison Co. truck is in position for proper pruning by Davy tree experts.**

**Figure D. Luminaire (in circle) with full foliage conditions and trees properly pruned.**

of Edgar A. Copel, Traffic Safety Engineer. A major cause of night-time accidents, thus study concluded, was lack of adequate artificial street illumination.

Seeking corrective recommendations, the Selectmen then asked my company to make a street lighting survey. I was assigned to analyze the lighting conditions in Brookline in terms of the I.E.S. Recommended Practice for Street Lighting.

At that time there were 1268 gas mantle lights in use, which were considered necessary because of the unusual foliage conditions. The town also had approximately 1200 incandescent lamps of all sizes, from 60 cp to 1500 cp, scattered through the extremely complicated system of street and highway intersections. A new system was designed in its entirety in 1941, but with World War II, all new installations came to an abrupt halt.

On a resolution of the Selectmen in 1950, the lighting project was eventually carried to completion. As an example of the practical application of the items which Mr. Edman has discussed in this paper, four photos are shown which exemplify work on tree trimming carried out under my direction as Consultant for the town of Brookline. The photos and their captions speak for themselves.

KIRK M. REID:* Printed Proceedings of the Street, Tree and Utility Conference, as reported in Mr. Edman's paper, are now available, single copy price $2.40. The Edison Electric Institute, 420 Lexington Ave., New York City, is handling this printing for widespread distribution among municipalites and utilities.

WARREN H. EDMAN:** I wsh to thank Mr. Halvorson for the added comments and the information on the Brookline, Mass., story. I hope it will add emphasis to the excellent job which was done at Brookline.

I also wish to thank Mr. Reid for his comments and making known that the printed proceedings of the Street, Tree and Utility Conference have been made available through the Edison Electric Institute at a low price which should enable widespread distribution.

*General Electric Co., Nela Park, Cleveland, Ohio.
**Author.

I.E.S. Golden Anniversary Conference

September 17-21 — Statler Hotel — Boston, Massachusetts

# Fitting a Roadway Lighting Plan To Buildings, Trees and Grounds

By DAVID A. TOENJES

A FINAL ROADWAY lighting installation often has important differences from its preliminary layout. In sketching the preliminary layout, usually on a large-scale street map, it is assumed that trees and other unmapped street conditions will not introduce major conflicts. When this layout is checked on the actual streets, there are often found to be conflicts that require either minor layout changes involving cooperative action with arborists or with other users of street space. This paper describes a new lighting installation in a park-type environment, and how the conflicts with trees and other surroundings were minimized by modifications in the layout and by cooperation with the arborists.

This new roadway lighting system was completed in the spring of 1954 at Nela Park, headquarters of the Lamp Division of the General Electric Company, in East Cleveland, Ohio. With mostly one-story and two-story buildings, all of Georgian architecture, the area resembles a college campus.

AUTHOR: Application Engineering, Large Lamp Dept., General Electric Co., Nela Park, Cleveland, Ohio.

It has about a mile of lighted roadways. The former lighting system had been upright post-top lanterns with 200-watt and 500-watt filament lamps operated base-down, at a height of about 13 feet above the roadway. The illumination upon the roadways under this system had been quite spotty, and had become inadequate because of more traffic through the park roadways. The former system had been in use since about 1920.

The average maintained illumination with the *new* system is from 0.5 to 1.0 footcandles on the various roadways, with an overall average of about 0.8 ft-c. This is about twice the American Standard Practice minimum recommendation applying to the same traffic conditions. The lighting uniformity — both of illumination and of brightness — is also greatly improved over the former system. For example, over the length of a representative span between luminaires, within the fluorescent-lighted part of the roadways, the ratio of average to minimum illumination is about 3 to 1.

Within this same fluorescent-lighted portion, the average maintained illumination measures just

**Figure 1. Fluorescent street lighting units — example of pole locations around curving roadway intersections.**

**Luminaire mounting heights are limited to 25 feet because of low buildings.**

Figure 2A. Fluorescent units in a one-side arrangement along a straight roadway.

Figure 2B. Night view in other direction after light rainfall. Broad light distribution gives pavement brightness pattern affording good visibility from curb to curb.

Figure 3. Lighting of the walks within the quadrangle and the roadways around it, using different pole heights to achieve the same luminaire heights with three different levels of grade. For example, there is a grade separation just beyond the roadway in the foreground.

Figure 4A. Shadows on the roadway before tree pruning.

Figure 4B. Shadows eliminated by pruning minor branches below the nearest luminaire.

under one footcandle. Based on these measurements, the maintenance factor for lamps and luminaires together is between 75 and 80 per cent — which is the factor that relates the *maintained* value to the *initial* value of illumination. Of course this applies for the specific conditions affecting this installation — moderately dirty atmospheric conditions, annual washing of the luminaires, and group relamping of the installation each two years.

The power requirements of the new and old lighting systems were quite similar, for equal lengths of average roadway throughout the installation. However, the total power load for lighting has been increased because it now includes roadways through some of the employee parking areas that were not lighted before. The total connected lighting load (not including parking areas) is about 18 kw of lamp ratings, covering 6200 feet (1.2 miles) of roadway with an average pavement width of 25 feet. Therefore the overall system uses about three lamp watts for each linear foot of pavement.

The new lighting installation serves a dual purpose — both for lighting the actual roadways, and for a practical demonstration of modern street lighting lamps and equipment. It includes roadways lighted with fluorescent, mercury, and filament lamp luminaires, and with a selection of various poles, mounting heights, and lighting equipment.

Adjustments that were made in the roadway lighting plan are separable into three broad types— depending upon whether the changes were made because of buildings, trees, or grounds. The following paragraphs describe some of these factors.

Building heights influenced the decision on mounting heights of the street lighting luminaires. Since the buildings are low, for reasons of appearance the luminaire mounting heights are generally limited to 25 feet. Lighting design, considered alone, would have favored a uniform mounting height of 30 feet, although 25 feet lies within the acceptable range indicated by the "American Standard Practice of Street and Highway Lighting." However, on a roadway past the main parking areas and a three-story factory building, the mounting height is 30 feet, for here it is in scale with its environment.

One main entrance of this building is separated from the roadway only by a pedestrian walk. It is desirable to have a high level of illumination in the vicinity of this doorway because of the heavy pedestrian traffic there at certain hours, entering and leaving the plant. Therefore, a wall-mounted street lighting luminaire has been located above this doorway, with its bracket arm fastened to the brick building wall. Its mounting height is 30 feet, to match the rest of the pole-mounted luminaires.

Colors of the street lighting poles were chosen to blend with their surroundings in various ways. Several pole colors are included for demonstration purposes but all poles are the same color within each part of the installation. The buildings are of red brick, trimmed with light gray stone and concrete. The pole colors used are brick red, stone gray and medium green, on the 25-foot poles. The 30-foot poles, that are of aluminum, are left in their natural color.

The trees bordering the roadways are mostly

**Figure 5. Secondary roadway, lighted by filament lamp luminaires. (Left) Shadowing in foreground caused by overhanging branches in front of nearest luminaire at left. (Right) View after pruning overhanging branches.**

**Figure 6. Fluorescent-lighted roadway. (Left) Dark area on roadway in foreground caused partly by shadowing from foliage, and partly by patches on roadway surface. (Right) Improvement in pavement brightness, from pruning the lower branches on the nearest tree.**

full-grown, and many of their major limbs overhang the roadways. The installation of new luminaires on 25-foot poles at the evenly-spaced locations suggested by the preliminary layout would have offered some serious conflicts with the trees even though the luminaires themselves were to be located out over the roadways on bracket arms.

After tree locations were carefully taken into account in determining the final pole positions, interference with the lighting was greatly reduced. It was necessary to prune only minor limbs and branches. One thing is especially to be noted — the inspection of the lighting must be made *after dark* to decide what pruning is needed. In the *daytime* inspection, after the poles had been erected and the luminaires mounted, one could not really tell which parts of the foliage, if any, would interfere with the light distribution. Inspection *after*

**Figure 7. (Left) Same portion of roadway, as in Fig. 6, from 100 feet farther downhill. Three poles are unevenly spaced to interfere as little as possible with white birch near center pole. (Right) Looking toward same pole and tree from across roadway, showing 20-foot displacement of pole to reduce the pruning necessary.**

*dark* quickly showed the shadows on the roadway. In most cases they were caused by the foliage on only small branches—either quite close to the luminaire, or in some cases at a farther distance but hanging down so as to block the light distribution near its angle of maximum candlepower. We noted which branches were responsible for interference, and they were pruned later. Another evening inspection showed that the shadows on the roadways had been reduced to a reasonable minimum. Examples, before and after this pruning, are shown in some of the illustrations.

The desired appearance of the grounds was another determining factor that affected the final roadway lighting plan. For example, we have already pointed out the effect upon mounting height of the luminaires. Another example is the main slope north of the Application Engineering Building, where there is the winding roadway upward from the lower main entrance. Here it was desired to keep the center part of the slope as free from street lighting poles as could be done without sacrifice of proper roadway illumination. During the Christmas season each year about 400,000 visitors drive up the roadway to see the annual Christmas lighting display. The unobstructed view up this slope always includes a major feature of the display. Because of this, the pole spacing is here extended to its effective limit of about 150 feet. The attendant loss in illumination uniformity was considered to be justified because this portion of roadway is straight; luminaires are spaced more closely around the curves at both ends of this straight portion.

The layout of the grounds, and the roadway locations, affected pole construction also. At some points the roadway runs along the top of a steep slope, and the retaining walls are either not wide enough or not strong enough to support the pole foundations. In one case the lower grade was reached by 34-foot poles to maintain the 25-foot mounting height above the roadway level. In the other case the poles had to be located on the *inside* of the curving roadway. A closer spacing made up for this departure from the usual recommended practice of placing lighting units around the *outside* of curving roadways.

Visitors to the area have shown interest in some of the details of the circuits and poles, and how they were installed. For example, at one place where a fluorescent luminaire was to be mounted we already had a steel pole with an adequate foundation and with anchor bolts in good condition. However, the pole was only 20 feet high, so a five-foot extension was welded onto the top of it. The necessary rigidity was obtained by using an extension of which the outside diameter matched the inside diameter of the existing pole, at its top end, so that a one-foot length of the extension could be slipped inside and then welded. The resulting strength was more than sufficient to support the fluorescent luminaire's weight, about 100 pounds.

Some of the poles have conventional bases, with handholes, but many are of the "transformer base" design, permitting larger handholes to make the circuit more accessible.

A new installation of multiple 120-volt circuits was made throughout the area. The conductors are placed underground because appearance is so important a consideration. Most of the former wiring dated from about 1920, when the lighting system had been first installed. The poles had been mounted on concrete foundations, but their bolts were badly rusted, so nearly all of the existing foundations were therefore abandoned and covered.

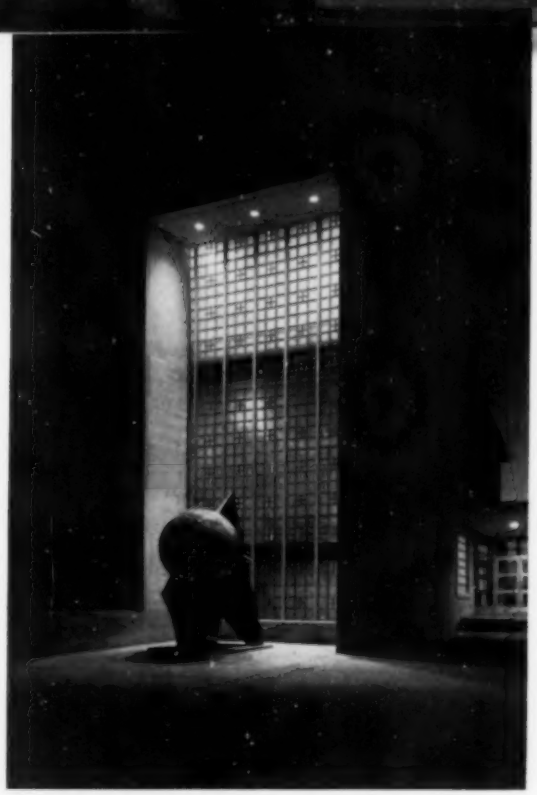
A supplementary proposal—of interest although not used here—was to include convenience outlets at the pole bases within the handhole covers. This was not done because the power requirements for the extensive Christmas lighting displays so greatly exceed the capacity of the roadway lighting circuits. However, in many business districts it would be feasible to put in sufficient extra circuit capacity, with outlets inside handholes near the tops of the poles, to offer provision for lighted Christmas decorations along the streets.

The time schedule of the new installation was of course affected by the weather and the time of year. Approval of the new installation was obtained, and construction begun, in the late fall of 1953. Before the ground was frozen, most of the concrete foundations for the poles were poured. Early the next spring, the conductors were laid and the poles installed. Even after the installation was completed, the necessary pruning was not attempted until trees were in full foliage, so that this pruning could be limited to the amount required to reduce foliage interference to its reasonable minimum.

Since completion of this lighting installation, it has been inspected, both day and night, by scores of interested visitors. These have included municipal and utility engineers, and others responsible for street lighting design or operation. A frequent comment has been that in spite of the large number of trees there is a surprising lack of conflict between them and the lighting. Such a harmonious use of streets, the author believes, can nearly always be achieved where the problems of conflicts are approached in a spirit of understanding and cooperation.

milj

# School Lighting System . . . with a single source



**Entrance to New Clayton High School**

IN AN EXHIBITION and competition, sponsored jointly by the American Association of School Administrators and the American Institute of Architects last year, the New Clayton High School in Clayton, Missouri was among the four top national winners. The award brought recognition to this school as an outstanding example of contemporary and functional school architecture. One of the factors in its design was to provide the highest quality lighting at lowest initial cost consistent with quality materials.

One feature of its economy was to hold to a minimum the variety of equipments and sources used in the design. No sacrifice was permitted, however, in the basic objective of required footcandle levels in a visually comfortable environment. Other requirements for the lighting installation were: that the lighting result must add to the overall atmosphere of the rooms; except in strictly functional areas, the lighting must create interest and at times be dramatic; all equipment for producing these results must be easily maintained and serviced.

The photograph above is a night-time shot of the main entrance, taken without benefit of any additional lighting. Note how dramatically the lighting points up the effect of the glass brick recessed wall, and provides interesting highlights and shadows on the figure of the "world." This effect, as well as the functional light provided, is from three elliptical recessed units, each using an R40 150-watt floodlamp.

A typical functional area is the Home Economics room shown below. Concentric ring units have been used, each with a 500-watt silvered bowl lamp, installed on 12 x 9-foot centers on the 11-foot ceiling. Average illumination level after five months (same lamps) was 38 footcandles. Similar installations in classrooms, library and other areas, have comparable levels. In all areas, careful attention has been given to surrounding brightness ratios, ease of maintenance, and our old friend Economy.

**Maintained level after five months is 38 footcandles in Home Economics Room.**

Lighting design by Brooks Chassaing, Art Metal Company, St. Louis, Mo. Architects: W. B. Ittner, Inc. Installation presented in 1955 MMILJ contest, St. Louis Section, I.E.S.

## Solving a Problem in a Press Room

A MAJOR PROBLEM at the *Catholic Register* was the obstructions created by the press machinery. Four areas had to be considered: Basement, where large rolls of newsprint are installed on the presses; main floor, having most of the active press work; area above the catwalk; and the general surrounding area in the press room. Some 16 luminaires are used for low level illumination of the area around the press. An additional 60 units light the press proper, installed in three rows on each side of the press, one row at the ceiling of the basement level, one row at the catwalk level and a third at the ceiling level of the press room.

For the main floor, long hangers were installed on the ceiling, supported by Unistrut running the length of the press. Luminaire installation was at an angle, so slanted that maximum light output was into the walkways between the sides of the press. A minimum of 40 footcandles is maintained for press work.

Stroboscopic effect was minimized by wiring ballasts within the fixtures as well as alternate fixtures, on opposite phases.

Installation by Glenn B. Gaer, Denver, Colo. Second prize in the Rocky Mountain Section MMILJ contest, 1955.

## Symmetry of Design in a Bank

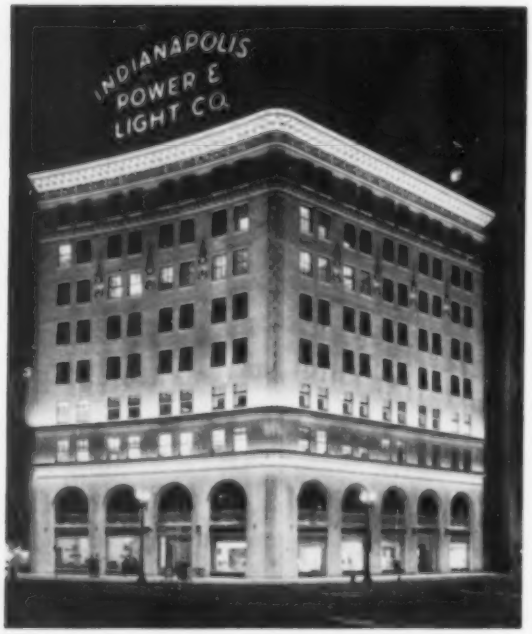
FUNCTIONAL SIMPLICITY for acoustical treatment, air conditioning, and lighting design was a specification for the Bank of America, Fresno, Calif. Modest budget was a factor, and high level, low brightness illumination distributed to meet the requirements of both customers and employees was, of course, required.

Symmetry and functional design were accomplished with a "daylight ceiling" technique of acoustical tile and translucent panel integration. Continuous rows of luminous panels parallel to the long dimension of the room and transversely connected at the end walls and doors, are spaced to follow desk, counter and customer areas.

For the illumination, sheet rock troffers were constructed in two- and four-foot widths, of 11 inches average depth. Troffer surfaces were treated for 80 per cent reflectance.

Very high levels were achieved (of the order of 60 footcandles at rear lobby desk varying to 100 ft-c under mezzanine). Comfortable brightnesses were accomplished by diffusing the light source through 40 per cent of the total ceiling area (as opposed to the 10 per cent accorded by conventional recessed lighting troffers). Four-foot troffers are located over all employee working areas and counters; two-foot troffers over the customer area. Simple service-station type wide arm lighting fixtures (6-inch lamp centers) were surface mounted within the troffers in continuous rows. Six-lamp fixtures were used in the 4-foot troffers and were wired for only four lamps to provide for possible future increase of illumination. Three-lamp fixtures, wired for two lamps were used in the two-foot troffers. Circuits are so arranged as to provide two levels of illumination throughout the bank, without shadowed areas in the translucent panels. Duct work was carried above the opaque acoustical tile and dropped to two-foot air diffusers located symmetrically between the luminous rows within the tile sections.

Installation by John M. Ohmura, F. K. Pinney Inc., San Francisco, California Golden Gate Section MMILJ contest, 1955.




## Exterior Floodlighting

A SUCCESSFUL floodlighting job invariably requires *engineering* to determine what luminaires to use, where to mount them, and how to make the installation inconspicuous in the daytime and dramatic at night. The installation shown achieves the basic objectives for exterior floodlighting: (1) Each portion of the building has proper brightness without distortion; basic form and depth of architecture is not destroyed. (2) Face of the building is illuminated to a level where texture and character are revealed. (3) Sufficient area at the base is illuminated so the building appears oriented with adjacent grounds and not suspended in the air. (4) Floodlights are located in such a position that they do not cause glare in the field of view of persons normally viewing the structure. In addition, the system is flexible and adapts to color requirements for different seasons. Almost all of the luminaires can be serviced by reaching through windows. Some 315 units were required, using 300-watt PAR56 spot lamps and protective lenses.

Installation by George E. Ransford, Indianapolis Power & Light Co. First prize winner Indiana Section MMILJ contest, 1955.

## Q and Q in Industrial Lighting

WHICH "Q" COMES FIRST in industrial lighting? Quantity or Quality? The installation at the Burndy Engineering Company, Lynwood, California achieves both, with flexibility also for later plant expansion. Upper-component type luminaires have been used in continuous rows at a 12-foot height, on 10-foot centers, using 96" slimline lamps. This system yields a maintained level of 60 foot-candles, with no supplementary equipment required.

Luminaires alone, of course, do not insure quality lighting. Walls, ceiling, floor and bench tops, as well as machinery have been finished in colors and of reflectances which which provide brightness ratios compatible with the "quality" objective. For best utilization of the upper-component luminaire, the ceiling area was painted a flat white. Walls are a pleasing green; benches and machinery a serviceable pastel green. All surfaces within the normal viewing angle of men working at the machines are well within the I.E.S. recommended limits of 3 to 1 ratio of task to immediate working area and within 10 to 1 in the visual field.

Management states that the seeing comfort in the machine shop has resulted in greater accuracy of work, increased production, decreased rejects, higher employee morale and reduced absenteeism.

Installation by R. B. Hatfield, Southern California Edison Co., Compton (California) District Commercial Office. Presented at Southern California Section M.M.I.L.J. contest, 1955.

# Development and Application Of Quartz Infrared Lamps

By MORGAN CHRISTENSEN
ALTON G. FOOTE

Since the days of the early cave man radiant energy has been used to preserve food by drying it in the sun, and this process is used today. For centuries man has also enjoyed the pleasant warmth of radiant energy from open fires. The filament lamp is a more recent source of radiant energy; it is used for these and many other heating tasks.

The processes of baking finishes, product heating, and product drying with radiant energy from infrared lamps have been well established during the past twenty years. Although applications are numerous and varied, the principal use has been in the baking of finishes. Infrared radiant heating has many unique advantages which have led to its acceptance as one of the main types of heating. Some of these advantages are: (1) almost instantaneous warm-up and cooling; (2) efficient operation, since energy is transferred directly from the source to the product; (3) low initial cost; (4) low operating and maintenance cost, as the lamps are operating only when neded, thus avoiding stand-by costs; (5) great flexibility; (6) space savings, since the equipment can often be mounted overhead or in otherwise unused pace.

For many years there has been a great need for a method of heating having these many advantages, which would also provide higher concentrations of radiant energy. In order to meet this need, the quartz infrared lamps shown in Fig. 1 have been developed with the objective of providing higher levels of energy.

Fig. 2 illustrates a special case where extremely high energy concentrations have been obtained. Here a double bank of lamps operated intermittently at double rated voltage provides over 550 watts per square inch of energy absorbed by a test surface. The energy density of the panel is nearly 150-kw per square foot. These types of installations, which will be described in further detail later, are aiding in research on supersonic flight.

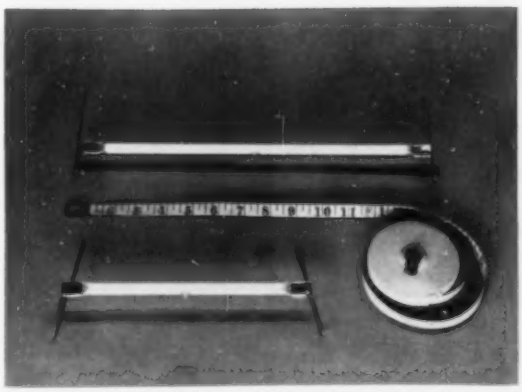


**Figure 1. The 500- and 1000-watt translucent quartz infrared lamps are shown unlighted. The nickel end caps protect the seals and strengthen the flexible leads.**

In addition to higher concentrations of energy it has often seemed desirable to have infrared lamps that were designed for higher voltages than 115-125 volts. The quartz infrared lamp is well suited to higher voltage design.

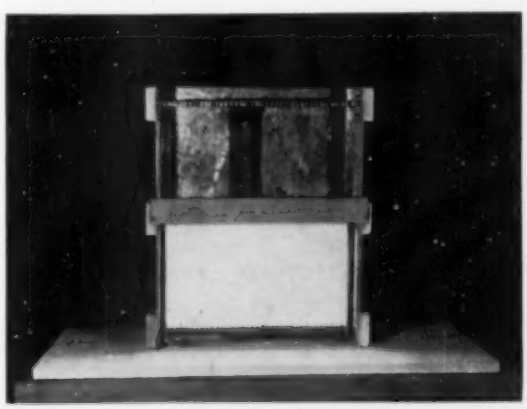


**Figure 2. This 73-lamp double bank unit operating for short periods of time at approximately 150 kilowatts per square foot is aiding in aircraft research. These lamps even though burning in a vertical position are giving satisfactory performance due to their short operating cycle.**

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 12-16, 1955, Cleveland, Ohio. AUTHORS: Application Engineering and Incandescent Lamp Engineering respectively, Large Lamp Department, General Electric Company, Nela Park, Cleveland, Ohio.

## Development

Tubular quartz infrared lamps were made in the laboratory as early as 1940. However, since these early lamps contained a relatively expensive graded seal, they would have been very costly. Also, the graded seal was not rugged enough to withstand the shock and vibration it would receive in many applications.

The development of the quartz to metal (molybdenum foil) seal made it practical to produce this new line of infrared lamps with their many unique characteristics. The ability of quartz to withstand high temperatures and thermal shock made relatively high wattage loading possible. The thermal shock properties of these lamps are illustrated in Fig. 3 where an ice cube is placed on the operating lamp.

The quartz which made this development possible is available in two types: (1) clear fused quartz and (2) translucent fused quartz. Clear quartz is made from high purity silicon dioxide in the form of clear natural crystals. Translucent quartz is made from a very pure grade of specially treated silicon sand. For most applications translucent quartz, considerably lower in cost, is satisfactory. However, clear quartz bulbs are required in some applications.

The lamps are double-ended, thus placing a uniform voltage gradient along the bulb. This practically eliminates any tendency to arc from lead wire to lead wire and makes possible a truly high voltage lamp. In special applications the lamps are operated as high as double rated voltage for short periods to produce still higher energy levels.

## Lamp Characteristics

While the physical shape of these lamps is a wide departure from other infrared lamps, they are still gas-filled tungsten filament lamps. The high-temperature tungsten filament has the same almost instantaneous warm-up to full output and high radiating efficiency of other infrared lamp filaments. Physically the lamp consists of a coiled tungsten filament held in the center of a quartz tube approximately three-eighths-inch in outside diameter. The molybdenum foil lead wires sealed in the ends of the bulb are attached to the filament. The seals are covered with a metal end cap, and six-inch flexible nickel leads are provided for making the electrical connections. Table I gives data on various lamps.

The starting characteristics of quartz infrared lamps are similar to those of other filament lamps. In-rush current is several times operating current. Circuit breakers and other equipments that are rated for use with incandescent lamps are usually satisfactory. However, in those special cases where the in-rush current is a problem it can be reduced by placing a "thermister" in series with the lamp. When the lamps are operated on a typical circuit the current decreases to its normal value in approximately one-third second for the 500- and 1000-watt lamps and about one-half second for the 2500- and 5000-watt lamps. In some special applications the lamps have been operated on constant current circuits; under these conditions they reach normal wattage in approximately two seconds.

The radiant energy from quartz infrared lamps is very nearly the same as that from other infrared lamps, since the color temperature of the filament is nearly the same. However, the quartz lamps radiate a portion of their energy beyond five microns. This is energy that has been absorbed by the quartz bulb and re-radiated. The amount of this energy is less for clear quartz lamps since less energy is absorbed. The luminous efficiency of quartz infrared lamps is essentially the same as that for other infrared lamps (approximately 8 lumens per watt).

Translucent quartz tends to diffuse the energy.

**TABLE I — Data on Quartz Infrared Lamps.**

| Watts | Circuit Voltage | Approx. Bulb O.D. | Filament | Max. Overall Length | Approx. Lighted Length | Base Type | Life* | Approx. Color Temp. | Bulb Type |
|---|---|---|---|---|---|---|---|---|---|
| 500 | 115-125 | ⅝" | C-8 | 8½" | 5" | 6-inch flexible leads | In excess of 5000 hours | 2400°K | Translucent quartz |
| 1000 | 230-250 | ⅝" | C-8 | 13½" | 10" | 6-inch flexible leads | In excess of 5000 hours | 2400°K | Translucent quartz |
| 1000** | 230-250 | ⅝" | C-8 | 11½" | 10" | 6-inch flexible leads | In excess of 5000 hours | 2400°K | Clear quartz |
| 2500 | 460-500 | ⅝" | C-8 | 28½" | 25" | 6-inch flexible leads | In excess of 5000 hours | 2400°K | Translucent quartz |
| 2500 | 460-500 | ⅝" | C-8 | 28½" | 25" | 6-inch flexible leads | In excess of 5000 hours | 2400°K | Clear quartz |
| 5000 | 920-1000 | ⅝" | C-8 | 53½" | 50" | 6-inch flexible leads | In excess of 5000 hours | 2400°K | Translucent quartz |
| 5000 | 920-1000 | ⅝" | C-8 | 53½" | 50" | 6-inch flexible leads | In excess of 5000 hours | 2400°K | Clear quartz |

*Lamps are designed for horizontal burning — end seal temperature must not exceed 650°F.
**For intermittent burning only.

which in effect makes the source size approximately equal to the tube diameter. In those applications where accurate focusing of the energy is required, clear quartz is desirable since the source then is, in effect, the small-diameter filament.

In some applications where the lamps are operated close together and at very high loading (watts per inch), translucent lamps become hot enough to exceed the softening point of quartz (approximately 3000°F). This is partly due to the absorption of some radiant energy by the translucent quartz. Since clear quartz absorbs less energy, these lamps can be operated under much more severe conditions before the quartz will soften.

## Equipment

Since the physical shape of the quartz infrared lamp is considerably different from that of other infrared lamps, entirely new reflectors and holders have been developed. The very high concentration of energy and the 650°F seal temperature limitation have made it necessary that reflectors and holders be well engineered in order to provide satisfactory performance.

The seal temperature limitation makes it necessary in many applications to design equipment where the ends of the lamp are outside the oven. In some cases, where extremely high ambient temperatures or high concentrations of energy are required, some method of forced air cooling of the lamp seals is used.

Since the source is very concentrated (100 watts per inch of lighted length) the reflecting surfaces have to withstand fairly high temperatures. Polished aluminum surfaces have worked out well in many cases. Research is now being conducted on gold and other metal surfaces for this application.

Several types of holders and reflectors have been developed for quartz infrared lamps. For many applications users are making special reflectors and holders to meet their specific requirements. In some cases the one-inch of non-radiating length at the end of most lamps has been used to support the lamp. When this is supported in an electrically insulated holder, these light-weight lamps can be kept securely in place by the flexible leads which are connected to terminals.

## Applications

Applications of quartz infrared lamps to date can be divided into four groups: (1) where high concentrations of radiant energy are required, (2) where a small size unit is desirable or required, (3) where there is a possibility of thermal shock to the lamp caused by moisture dropping on the bulb, and (4) where energy concentrated into a narrow band is required.

### *High Concentrations*

The higher concentrations of energy which quartz infrared lamps can provide is the chief factor which should greatly expand radiant heating applications. Product temperatures far greater than those previously obtainable can now be easily achieved. One of the largest applications to date has been in aircraft research. Banks of lamps have been used to provide very high concentrations of energy on aircraft surfaces in order to simulate the skin temperature rise which they attain in supersonic flight. At speeds somewhere beyond 10 times the speed of sound, temperatures reached on the surface of aircraft due to air friction are estimated to be high enough to melt any presently-known materials.

In order to attain the extremely high concentrations of energy necessary for the above application quartz infrared lamps are very closely spaced, often as close as half-inch centers. For maximum concentrations two banks of lamps are used. One is placed behind the other with the filaments of the lamps in the rear bank positioned between the lamps in the front row. The lamps in these banks are usually operated for short periods (1-5 seconds) at double-rated voltage (approximately triple wattage).

In order to further increase the rate of temperature rise, the test surfaces are usually blackened to increase their absorption. Also, in these very high concentration applications it is necessary to use clear quartz since the translucent quartz absorbs more energy and in this application has actually softened in some cases.

Since the lamps come up to full output almost instantaneously, the test sample can be placed in front of the lamp bank and measurements started as soon as the lamps are turned on. This is a big advantage, since a source that had appreciable thermal lag would require thermal barriers between the test sample and the source. Under these conditions the source would have to come up to temperature, then the barrier would have to be removed and measurement could be commenced.

More recent applications of this type use 2500- and 5000-watt quartz lamps. Since these are longer they minimize the non-radiating area in the bank and thereby permit higher and more uniform energy concentrations. One research organization is considering operation of the 50-inch lamp on a 2300-volt line for about five seconds.

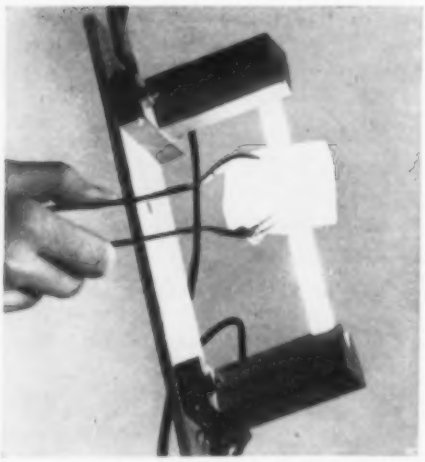


**Figure 3. The ice cube held on the lighted lamp demonstrates its ability to withstand thermal shock.**

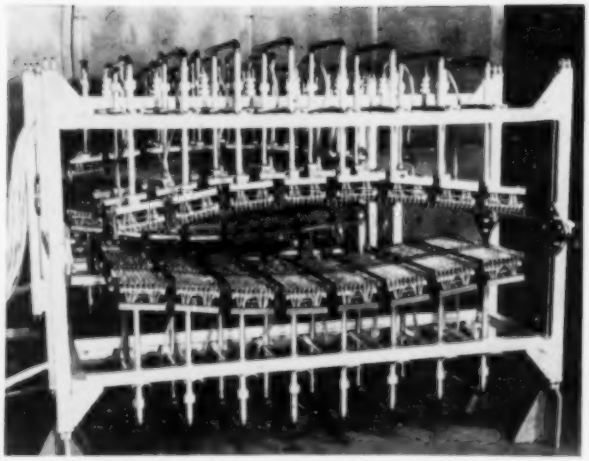


**Figure 4. The units in this installation using clear quartz 1000-watt lamps can be adjusted to fit various aerodynamic contours.**

Fig. 4 shows a more elaborate installation using 1000-watt clear quartz lamps. This device can be adjusted for various aerodynamic contours. Other installations have been made in altitude test chambers. The 1000-watt clear quartz infrared lamps are designed for intermittent burning only. In order to decrease the overall length of the lamp for increased energy concentration, these lamps do not have the inch of non-lighted length between the filament and the seal. The other quartz infrared lamps have the 1-inch non-lighted length in order to provide a high temperature difference between the filament and the seal. This permits the lamps to operate in higher ambient temperatures and still not exceed the 650F seal temperature limitation.

Quartz infrared lamps are also being used to set some types of ink. High concentrations of energy are required for these applications since high press speeds are involved. The lamps are also receiving considerable interest from the textile industry. By adding radiant energy sources to their present drying facilities they are able to increase production. Since most fabrics are less than 48 inches wide, the construction of these installations has in some instances been simplified by the use of the 5000-watt, 50-inch lighted length lamps. In some instances where available, these lamps have been operated at 575 volts. At this voltage the lamps operate at approximately 2400-watts.

***Smaller Size***

Since these lamps are small in diameter they find application in many places where other lamps cannot physically fit. In many instances the size of the oven itself is reduced. An example of this is the portable shrink fit oven shown in Figs. 5 and 6 which contains twelve 1000-watt quartz infrared lamps. This unit has twice the usable space for the same outside dimensions as an older unit using reflector-type infrared lamps.

The small unit shown in Fig. 7 is used to expand pinion gears before they are placed on the armature shafts of the traction motors of Diesel-electric locomotives. A test in one railroad maintenance shop showed a 325°F rise in 23 minutes using this unit compared to only a 170°F rise in the same length of time using their present methods. At 325°F the maximum temperature variation on the pinion is only 12°F.

**Figure 5. This oven is used to expand bearings before they are placed on shafts. Twelve compact 1000-watt quartz infrared lamps are used.**

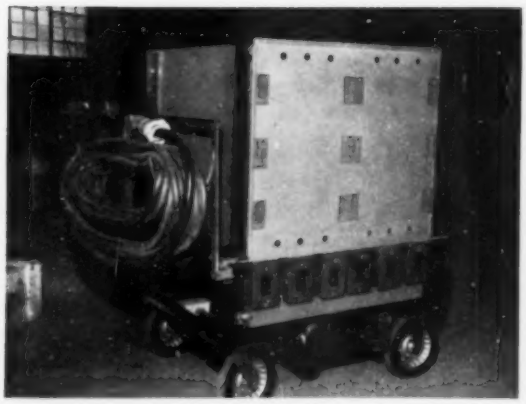


**Figure 6. The portability is shown in the external view. Six switches are provided to control the amount of energy in the oven. The perforated metal openings provide cooling for the ends of the lamps.**

**Figure 7. A small oven containing eight 500-watt quartz infrared lamps is shown being used to heat a pinion gear prior to its insertion on an armature shaft.**

The long tubular shape of these lamps also makes the designing of installations having very uniform energy distribution easier. Uniformity is usually important; however, in some applications where the product is a poor conductor of heat it is essential. One example of this is the heating of plastic sheets.

### *Thermal Shock*

Since the quartz bulb has an extremely low coefficient of thermal expansion (about $^1/_{20}$ that of ordinary lime glass), these lamps are practically impervious to thermal shock. For this reason they are being used extensively in food warming devices where splattering grease or moisture might break the other types of infrared lamps.

The quartz infrared lamps will undoubtedly be used in paint baking applications, even though the energy concentrations provided by other types of lamps are adequate. Since the quartz lamps are not subject to thermal shock and are less apt to be broken mechanically, the hazard of exposed lamp filaments in these applications is greatly reduced.

There are many other applications where a source with this characteristic is required.

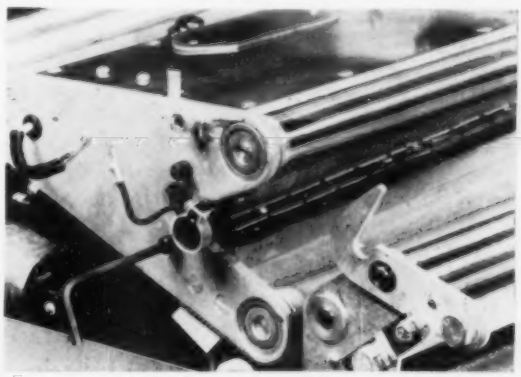


**Figure 8. This is an interior view of an office type copying machine which uses a quartz infrared lamp in an elliptical reflector to provide a very high concentration of energy.**

**Figure 9. The controls and physical appearance of the office type copying machine are shown in this view. The material to be copied and a temperature sensitive paper are inserted in the top slot; a belt carries them past the lamp, and a copy and the original come out the bottom slot in about four seconds.**

***Concentrated Band***

Another type of application for which these lamps are particularly well suited is one requiring a concentrated band of energy. When these tubular sources are located at one focus of an elliptical reflector they produce very concentrated heating of products located at the other focus. This principle has been used previously with other types of infrared lamps, but since better control and higher temperatures can be obtained with this new tubular source these applications will be substantially increased.

Figs. 8 and 9 show inside and outside views of a new office type copying machine that uses this principle. A temperature sensitive paper that turns dark when heated is used in this device. A sheet of this paper is placed over the piece to be copied and they are carried on a belt past the secondary focus of the elliptical reflector. The darker areas of the original absorb more of the radiant energy that the light areas, locally heating the temperature sensitive paper, and thereby reproducing the original all in about four seconds. The speed of the belt can be controlled for various types of originals. The lamp used in this machine has several special construction features to meet the requirements of this application.

The unique advantages of this new type source have filled a long-felt need in the infrared field. The applications shown are only an indication of the tremendous potential of this device. These uses will undoubtedly be multiplied many times as the capabilities of these lamps are more fully realized and utilized. Certainly this new tool for heating, drying, and baking introduces a new era in the rapidly-expanding infrared application field.

## DISCUSSION

IRA J. BARBER:* From the standpoint of the oven manufacturer the quartz lamp presents both advantages and problems. With the previously available lamps, energy input concentrations of 22.5 watts per square inch have been theoretically possible, but for reasons of mechanical practicability it has seldom been feasible to exceed 11 or 12 in production service. Similarly, the terrific concentrations of 1000 watts per square inch mentioned in the paper are not practical from a commercial standpoint. It appears, however, that flat bank concentrations of 40 watts per square inch can be maintained for practical periods of time and in practical equipment. If two units of such output were opposed, in normal efficiency ranges a black metal panel should be expected to reach an ultimate temperature of 1600F. Perhaps of equal importance, a piece of 22 gauge metal, for example, could be brought from room temperature to 400F in five seconds! Where the lamps can be disposed cylindrically around the product, this might be further cut to two or three seconds! The venetian blind industry — to mention one — might be interested in such short cycles.

These higher rates and temperatures have already created considerable interest in the textile field and should prove very effective for slashers, tenter frames, wool carbonizers and all general cloth drying. Also, they should present speed and control advantages in firing porcelain enamel and such ceramic processing as comes under the 1600F range.

While the quartz lamp may be satisfactorily controlled through the use of intermittent devices such as percentage timers, its one distinguishing feature as compared to all other tubular type heating sources is its instant response to voltage interruption or variation. The high temperatures at which the lamp is designed to work make this property very valuable in protecting products from damage in case of shut-down. Particularly in the case of paper, cloth or other flammable material, it will permit safe processing at much higher rates than possible with sources of greater mass, and the companion property of requiring no preheat time is of importance in many applications.

On the disadvantage side, there are some problems in providing equipment, especially reflectors, which will withstand the high temperatures. The surface temperature of the lamps at full voltage is above 1000F, and on close centers, the reflectors are quite near the lamps. Research has found one or two suitable materials, however, and high tmperature equipment should not be long in coming on the market. Quartz has little transmission of radiation beyond 5 microns, which means that the source must be operated at about 1300F or over to have a major part of its generated heat radiate through the walls of the tube. Below this level, most of the energy radiated from the source is absorbed by the tube, and thence dissipated as convection heat or radiated at wavelengths corresponding to the temperature of the quartz. Where the lamps are operated in the "black heat" range, their performance is entirely that of a quartz tube heated to the same temperature by any means. At ¼ rated voltage, however, the tungsten filament is still principally radiating its energy, although like all radiant sources, at a lower efficiency than when operated at higher temperatures.

By way of summation, I should say that the quartz lamp opens new avenues to market, and from a commercial viewpoint injects a new stimulus into the entire radiant heat picture.

MORGAN CHRISTENSEN and A. G. FOOTE:* The authors wish to thank Mr. Barber for his discussion of their paper. It is particularly gratifying to have this discussion from someone who has had wide experience in the radiant heating field.

*Vice-President, The Fostoria Pressed Steel Corp., Fostoria, Ohio.

*Authors.

INSTALLATION AT PENN FRUIT CO., CITY LINE AVE.
AND CONSHOHOCKEN STATE RD., PHILADELPHIA, PA.

# Lighting a Supermarket

**LIGHTING OBJECTIVE:** To provide merchandising modeling effects together with high level illumination in a self-service supermarket.

**GENERAL INFORMATION:** The main floor sales area shown above measures 152 feet long by 130 feet wide. The barrel roof ceiling construction curves from 22 feet high in the center down to 16 feet at the longitudinal sidewalls. Colors and reflectances are as follows:

| | | |
|---|---|---|
| ceiling | white | 80% RF |
| walls | | |
| back | orange | 25% RF |
| side | yellow | 65% RF |
| front | glass | |
| floor, terrazo | light gray | 40% RF |
| counter fronts | white | 55% RF |

(over)

A.I.A. File No. 31

**INSTALLATION:** Mostly incandescent light sources were chosen for this installation to prevent the flatness which occurs when fluorescent light sources are used exclusively in this type of installation. The incandescent component adds highlight and sparkle to the fruits, vegetables and other merchandise.

General illumination is provided by 132 twin-assembly units suspended 40 inches below the ceiling and located on 14-foot by 11-foot spacings. Each twin-assembly unit consist of two "Lobay" intensive distribution prismatic glass reflector units (Holophane Company catalog No. 685) mounted in a special decorative light shield (Klemm Reflector Company catalog No. KE 491) and equipped with 500-watt PS-40 inside frosted general service lamps. The exterior baked enamel finish on each of the decorative light shields was provided in one of the following five colors: green, light blue, purple, red and orange. The sign track which runs around the side and back walls is illuminated by 174 wiring channels (Metalcraft Products Company catalog No. C1400) located in a double lamp arrangement and positioned so that the lamps overlap to provide a smooth lighting effect. Each channel is equipped with one 40-watt T-12 deluxe warm white rapid start fluorescent lamp. Average general illumination, three months after store opened, measured 65 footcandles. Brightnesses are as follows:

| | |
|---|---|
| twin-assembly units | |
| at 60° | 380 ft-L |
| at 45° | 3900 ft-L |
| sides | 31 ft-L |
| ceiling | |
| between units | 35 ft-L |
| adjacent to units | 162 ft-L |
| walls | |
| back, orange | 47 ft-L |
| back, scallop | 32 ft-L |
| side, yellow | 58 ft-L |
| floor | 41 ft-L |
| counter fronts | 50 ft-L |

**Cooperating in lighting design: George E. Shoemaker, Philadelphia Electric Co., 1015 Chestnut St., Philadelphia, Pa.; architects: Thalheimer & Weitz, 1315 Walnut St., Philadelphia, Pa.; electrical contractor: Ford & Morris, 327 South 20 St., Philadelphia, Pa.; for the Penn Fruit Co., Grant Ave. and Blue Grass Rd.: Angelo Aquaro, architect, and Otis Besore, engineer.**

**Lighting data submitted by George T. Anderson, Jr., Philadelphia Electric Co., 1015 Chestnut St., Philadelphia, Pa., as an illustration of good lighting practice and to aid in the design of similar installations.**

**Published by the Committee on Publications of the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.**

# Calculating Coefficients Of Utilization

**A report of the Committee on Lighting Design Practice of the Illuminating Engineering Society**

## Foreword

For several years it has been recognized that the method of making lighting calculations for interiors has been in need of improvement with respect to accuracy and simplification. With such improvement as a goal, the Lighting Design Practice Committee has studied the method of classifying rooms according to shape (room index or room ratio), the method of calculating coefficients of utilization, the room surface reflectance combinations for which coefficients of utilization should be published, and all of the foregoing with respect to simplification of the calculations that are necessary in the field to determine the number of luminaires required to produce specified illumination levels.

After intensive study, particularly during the past year, the Committee is now in a position to make recommendations on two of the above subjects: (1) the method of calculating coefficients of utilization, and (2) the room surface reflectance combinations for which coefficients of utilization should be published.


COMMITTEE ON LIGHTING DESIGN PRACTICE

B. S. Benson, Jr., *Chairman, 1954-1955*
J. R. Jones, *Chairman, 1952-1954*

| | |
|---|---|
| G. W. Clark | J. A. Losh |
| Kurt Franck | J. J. Neidhart |
| Ward Harrison (54-55) | J. F. Parsons |
| Neal Jacobus | W. M. Potter |
| J. O. Kraehenbuehl | G. G. Rae |
| Norman Kridel (54-55) | E. H. Salter |


## Calculating Coefficients of Utilization

### *Background*

The present method of calculating coefficients of utilization[1] is an empirical one based on tests made in the period from 1915 to 1920. The tests and the resulting method were designed to accommodate the luminaires of that period arranged as was the prevailing practice. Since then, new light sources, control media and processes have been developed, and new luminaire distributions, not evaluated in the tests, have become prevalent. The arrangement of luminaires and the number installed in a given area have also changed, thus influencing the average illumination. During the period when the tests were made it was a rather common practice to install one luminaire having a spread distribution over the center of the room; thus the coefficient of utilization was higher than if additional luminaires were installed nearer the wall, as is now the common practice. Another factor introducing error into the system was the cosine error of the testing plate used in making the test measurements. This caused the readings to be several per cent lower than the correct value, particularly in large rooms. Thus, it is evident that the method has been used as the basis for calculating coefficients for luminaire types and installation arrangements not covered in the original tests. In spite of these limitations, which were pointed out by the authors in their classic work, the method served the industry well for many years. However, improvements are now possible.

The Lighting Design Practice Committee has studied the available methods[1,2,3,4] in order to recommend a method that is as accurate and as simple as practicable, and that may be used equally well for all luminaire types and distributions. After a thorough study of measured versus calculated coefficients of utilization, and of the methods themselves, the Committee recommendation is presented herewith.

### *Recommendation*

The Committee recommends to Council that the Society adopt the Zonal-Factor Interflectance Method* as the currently preferred method of calculating coefficients of utilization for interior luminaires.


Report approved by the Council of the Illuminating Engineering Society, October 8, 1953; Appendix approved March 10, 1955.


## Room Surface Reflectances

### *Background*

The original tests and the Lumen Method as originally developed by Harrison and Anderson provided data for a wide variety of room surface reflectance combinations. In the years that followed, an abridgement of those reflectance combinations became a common practice in publishing coefficients of utilization. In this process, an average of the values for the 70 per cent and 80 per cent ceiling published in the original work was used to obtain factors for reflectance combinations involving a 75 per cent ceiling. This had the effect of causing the calculated coefficients of utilization to be unnecessarily conservative when the ceiling was white. Since ceiling reflectances of slightly over 80 per cent are now common, it appears that such an abridgement is not currently justified and reflectances of 80 per cent should again be comprehended. The Committee recommendations follow:

### *Recommendation*

The Committee recommends to Council that coefficients of utilization be published for the following reflectance combinations:

**Reflectance Combinations**

| Ceiling Reflectance (per cent) | Wall Reflectance (per cent) | | | Floor Reflectance (per cent) | |
|---|---|---|---|---|---|
| 80 | 50 | 30 | 10 | 10 | 30 |
| 70 | 50 | 30 | 10 | 10 | 30 |
| 50 | 50 | 30 | 10 | 10 | 30 |
| 30 | 50 | 30 | 10 | 10 | 30 |
| 10 | 50 | 30 | 10 | 10 | 30 |
| 0 | 0 | 0 | 0 | 0 | 0 |

Where an abridgement of the above reflectances is desired, it is recommended that coefficients for industrial luminaires be published for the following reflectances:

**Reflectance Combinations**

| Ceiling Reflectance (per cent) | Wall Reflectance (per cent) | | | Floor Reflectance (per cent) |
|---|---|---|---|---|
| 70 | 50 | 30 | 10 | 10 |
| 50 | 50 | 30 | 10 | 10 |
| 30 | | 30 | 10 | 10 |

*See appendix.

For all luminaires except those classified as "industrial" the following abridgement is recommended:

**Reflectance Combinations**

| Ceiling Reflectance (per cent) | Wall Reflectance (per cent) | | | Floor Reflectance (per cent) |
|---|---|---|---|---|
| 80 | 50 | 30 | 10 | 10 |
| 70 | 50 | 30 | 10 | 10 |
| 50 | 50 | 30 | 10 | 10 |

These minimum recommendations are made only to promote as much standardization of published data as practicable, and are not meant to deter manufacturers from publishing coefficients for additional reflectances. Where coefficients of utilization are abridged in a manufacturer's published data to omit a 30 per cent ceiling reflectance, then an adjacent statement should be made calling attention to the fact that the loss of light due to a 30 per cent ceiling, compared to a 50 per cent ceiling, is even greater than the loss between a 70 per cent and a 50 per cent ceiling. The Committee looks with favor on the publication of coefficients for as many reflectance combinations as possible.

**References**


1. Harrison, Ward, and Anderson, E. A.: "Coefficients of Utilization," *Transactions of the Illuminating Engineering Society*, Vol. XV, No. 2, p. 97 (March 1920).

2. Moon, P., and Spencer, D. E.: *Lighting Design*, Addison-Wesley Press, Cambridge, Mass. (1948). Report No. 3 of the Committee on Standards for Quality and Quantity of Interior Illumination. "The Interreflection Method of Predetermining Brightnesses and Brightness Ratios." ILLUMINATING ENGINEERING, Vol. XLI, No. 5, p. 361 (May 1946). Moon, Parry, and Spencer, D. E.: "Light Distributions in Rooms," *Journal of the Franklin Institute*, Vol. 242, No. 2 (August 1946).

3. Jones, J. R., and Neidhart, John J.: "Coefficients of Utilization for Luminaires with Concentrating Distributions," ILLUMINATING ENGINEERING, Vol. XLVI, No. 12, p. 601 (December 1951). Jones, J. R., and Neidhart, John J.: "The Zonal Method of Computing Coefficients of Utilization and Illumination on Room Surfaces," ILLUMINATING ENGINEERING, Vol. XLVIII, No. 3, p. 141 (March 1953).

4. Coradeschi, R. A., and Innis, L. L.: "An Application of the Interflection Theory to Commercial Practice," ILLUMINATING ENGINEERING, Vol. XLIII, No. 11, p. 949 (November 1948).

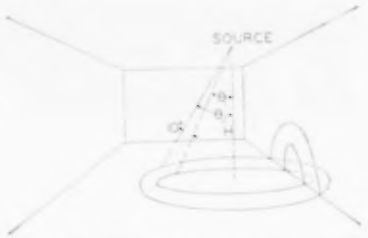

## APPENDIX — ZONAL FACTOR INTERFLECTANCE METHOD

The Zonal Factor Interflectance Method of calculating coefficients of utilization considers the ultimate disposition of the flux from every 10-degree zone from the luminaire. The flux in each 10-degree zone (0-10 degrees, 10-20 degrees, etc.) that strikes the work plane directly is determined from zonal factors, and to that is added the flux that reaches the work plane (horizontal plane 30 inches above floor) by interreflection. The ratio of the total flux reaching the work plane to the lamp lumens is the coefficient of utilization.

This method was developed by assuming specific symmetrical luminaire locations in a square room representing each room ratio. Then, for each luminaire location in a given room size, the percentage of the lumens in each of the 10-degree zones that strike the work plane directly was calculated (see Sketch A). By averaging the percentages for a given zone for all the luminaires, an average percentage for that zone was obtained. Such average figures, called zonal factors, have been prepared for each 10-degree zone for rooms of room ratio 5.0 (A) through 0.6 (J) for various spacing arrangements. They are in no way influenced by the distribution of the luminaire, but are effective for all luminaires. To apply the method to a specific luminaire the luminaire lumens in each zone are multiplied by the appropriate zonal factor. The sum of these products for a specific room index, when divided by the total downward (0-90 degrees) lumens of the luminaire, is the percentage of downward lumens that strike the work plane directly. This quantity is the Direct Ratio. To this ratio is added the percentage (expressed as a decimal) of luminaire lumens that are *reflected* to the work plane. This reflected component has been determined from interflectance data.

The following reflected component curves based on the recommended room surface reflectances,* are made available to facilitate determination of the Downward Reflected Component and the Upward Utilization Factor (see Step-by-Step Procedure).

*Curves are not included for ceiling reflectance of 10 per cent or ceiling reflectance of 30 per cent combination with 30 per cent floor reflectance. There are no reflected components when room surfaces have 0 per cent reflectance.




**Sketch A. The flux in any zone that strikes the work plane directly is equal to the total lumens in the zone minus the lumens that strike the wall.**

Work sheets are provided to facilitate systematic computation of the coefficients. The sheet including zonal multipliers should be selected which corresponds most closely with the spacing-to-mounting-height (above the work plane) ratio at which the luminaires will generally be installed in practice. Low spacing-to-mounting-height ratios are applicable for narrow distribution luminaires and for low lumen output luminaires.

### Step-by-Step Procedure for Computing Coefficients of Utilization

Enter pertinent data in the heading of Work Sheet I (entitled "Work Sheet for Computing Coefficients of Utilization"). This information can be obtained from the photometric data of the luminaire.

The steps to be followed in computing the coefficients of utilization for the luminaire are as follows:

Totally Direct Luminaires—Step 1 only.
Totally Indirect Luminaires—Step 2 only.
All other Luminaires—Steps 1, 2 and 3.

### Step 1. Determine the Downward Coefficients as follows:

(a) Select the proper "Work Sheet for Computing Direct Ratio" on the following basis:

| If Recomended Maximum Spacing-to-Mounting-Height Ratio above Work Plane is — | For Luminaires using Incandescent or Mercury Lamps, use — | For Luminaires using Fluorescent Lamps, use — |
|---|---|---|
| 1.0 | Work Sheet II a | Work Sheet II f |
| 0.9 | Work Sheet II b | |
| 0.8 | Work Sheet II c | in |
| 0.7 | Work Sheet II d | |
| 0.6 | Work Sheet II e | every |
| 0.4 | Work Sheet II f | case* |

*While fluorescent luminaires usually have spread-type light distributions with recommended maximum spacing-to-mounting-height ratios of approximately 1.0, the characteristic low light output of fluorescent lamps generally requires spacing the luminaires in continuous rows or on otherwise much closer centers than necessary from the standpoint of lighting uniformity alone. It is for this reason that Work Sheet II f (normally for a spacing-to-mounting-height ratio of 0.4) is used for all fluorescent luminaires.

(b) Enter the luminaire lumens for each 10 degree zone in appropriate column on selected work sheet and multiply these zonal lumens by their respective zonal multipliers for each value of Room Ratio (Room Index).

(c) Total the column under each value of Room Ratio. This gives the total luminaire lumens that strike the work plane directly (without being reflected from the room surfaces to the work plane).

(d) Divide the totals obtained in Step 1c (above) by the total luminaire lumens in the 0-90 degree zone. The results are the Direct Ratios and should be inserted in the appropriate spaces on Work Sheet I. These values are not dependent upon room reflectances.

(e) Determine the Downward Reflected Components from the appropriate graphs selected as follows:

Fig. 1a — Ceiling Mounted Luminaires — 10 per cent reflectance. (Use for all commercial type luminaires that will be mounted on, recessed into, or suspended within 12 inches of the ceiling.)

Fig. 1b — Ceiling Mounted Luminaires — 30 per cent floor reflectance. (Same luminaire description as for Fig. 1a.)

Fig. 2a — Suspended Luminaires — 10 per cent floor reflectance. (Use for all industrial type luminaires and those commercial type luminaires suspended 12 inches or more below the ceiling.)

Fig. 2b — Suspended Luminaires — 30 per cent floor reflectance. (Same luminaire description as for Fig. 2a.)

NOTE: Graphs for 10 per cent floor reflectance should be used unless the coefficients of utilization are specifically designated as being for 30 per cent floor reflectance.

For each Direct Ratio obtained in Step 1d, and for each value of ceiling and wall reflectance to be used, determine the Downward Reflected Component. This gives the percentage of downward luminaire lumens that are reflected to the work plane by the room surfaces. These values should be inserted in the appropriate spaces on Work Sheet I.

(f) Add the Direct Ratio and the Downward Reflected Component. This sum is the Downward Utilization Factor, the total per cent of downward luminaire lumens that reach the work plane.

(g) Multiply the Sums (Downward Utilization Factors) by the per cent of lamp lumens emitted downward by the luminaire (obtained from heading of Work Sheet I). These results are the Downward Coefficients and, if the luminaire is *Totally Direct*, are also the Coefficients of Utilization.

**TABLE 1a.—Upward Utilization Factors, Ceiling Mounted Luminaires, 10 per cent Floor Reflectance.**

| Ceiling | | 80% | | | 70% | | | 50% | | | 30% | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Walls | | 50% | 30% | 10% | 50% | 30% | 10% | 50% | 30% | 10% | 30% | 10% |
| Room Ratio | Room Index | | | | | | | | | | | |
| 0.6 | J | .264 | .193 | .135 | .234 | .166 | .120 | .159 | .119 | .079 | .074 | .050 |
| 0.8 | I | .350 | .273 | .220 | .310 | .244 | .196 | .219 | .173 | .134 | .099 | .079 |
| 1.0 | H | .420 | .345 | .288 | .370 | .303 | .256 | .262 | .216 | .178 | .123 | .098 |
| 1.25 | G | .498 | .416 | .360 | .428 | .365 | .314 | .301 | .256 | .222 | .138 | .118 |
| 1.5 | F | .549 | .476 | .415 | .473 | .412 | .361 | .333 | .288 | .256 | .152 | .132 |
| 2.0 | E | .619 | .555 | .500 | .532 | .482 | .436 | .368 | .333 | .306 | .168 | .148 |
| 2.5 | D | .665 | .605 | .560 | .570 | .525 | .485 | .396 | .366 | .340 | .186 | .166 |
| 3.0 | C | .695 | .650 | .596 | .598 | .561 | .520 | .412 | .387 | .362 | .198 | .180 |
| 4.0 | B | .734 | .701 | .648 | .634 | .608 | .569 | .436 | .416 | .387 | .210 | .189 |
| 5.0 | A | .760 | .732 | .690 | .662 | .637 | .603 | .446 | .430 | .416 | .225 | .205 |

**TABLE 1b.—Upward Utilization Factors, Ceiling Mounted Luminaires, 30 per cent Floor Reflectance.**

| Ceiling | | 80% | | | 70% | | | 50% | | | 30% | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Walls | | 50% | 30% | 10% | 50% | 30% | 10% | 50% | 30% | 10% | 30% | 10% |
| Room Ratio | Room Index | | | | | | | | | | | |
| 0.6 | J | .271 | .198 | .140 | .238 | .170 | .126 | .165 | .125 | .085 | .085 | .060 |
| 0.8 | I | .368 | .282 | .225 | .320 | .248 | .200 | .225 | .180 | .140 | .110 | .090 |
| 1.0 | H | .452 | .353 | .293 | .388 | .310 | .260 | .270 | .225 | .185 | .135 | .115 |
| 1.25 | G | .529 | .430 | .365 | .455 | .376 | .320 | .320 | .270 | .235 | .150 | .130 |
| 1.5 | F | .590 | .500 | .432 | .510 | .430 | .375 | .350 | .300 | .270 | .165 | .145 |
| 2.0 | E | .676 | .592 | .530 | .580 | .510 | .460 | .390 | .350 | .320 | .190 | .170 |
| 2.5 | D | .735 | .661 | .600 | .630 | .570 | .518 | .420 | .385 | .355 | .205 | .190 |
| 3.0 | C | .777 | .715 | .660 | .665 | .610 | .560 | .445 | .410 | .385 | .225 | .205 |
| 4.0 | B | .835 | .785 | .731 | .712 | .665 | .620 | .475 | .445 | .425 | .240 | .220 |
| 5.0 | A | .872 | .830 | .782 | .742 | .702 | .662 | .490 | .470 | .450 | .250 | .230 |

**Step 2. Determine the Upward Coefficient as follows:**

(a) For Suspended Luminaires:

i. On Work Sheet III ("Work Sheet for Computing Ceiling Ratio") enter the luminaire lumens for each 10-degree zone in appropriate column and multiply these zonal lumens by their respective zonal multipliers for each value of Room Ratio (Room Index).

ii. Total the column under each value of Room Ratio.

iii. Divide the totals obtained in Step 2a,ii by the total luminaire lumens in the 90-180 degree zone. These are the ceiling ratios, the percentages of upward luminaire lumens that strike the ceiling directly, and should be inserted in the appropriate column on Work Sheet I.

iv. Determine the Upward Utilization Factors from the appropriate graphs selected as follows:

Fig. 3a — Suspended Luminaires — 10 per cent floor reflectance.

Fig. 3b — Suspended Luminaires — 30 per cent floor reflectance.

NOTE: Graphs for 10 per cent floor reflectance should be used unless the coefficients of utilization are specifically designated as being for 30 per cent floor reflectance.

For each Ceiling Ratio obtained in Step 2a,iii, and for each value of ceiling and wall reflectance to be used, determine the upward utilization factor. This is the percentage of upward luminaire lumens that are reflected to the work plane by the upper walls and ceiling and by interreflection from all room surfaces. These values should be inserted in the appropriate spaces on Work Sheet I.

v. Multiply each upward utilization factor by the per cent of lamp lumens emitted upward by the luminaires (obtained from heading of Work Sheet I). These results are the upward coefficients and, if the luminaire is *Totally Indirect*, are also the Coefficients of Utilization.

(b) For Ceiling Mounted Luminaires:

i. For ceiling mounted luminaires, steps similar to Step 2a,i,ii,iii and iv (above) are omitted and the upward utilization factors obtained directly from Table 1a (10 per cent floor reflectance) or Table 1b (30 per cent floor reflectance). Enter the values of upward utilization factors in the appropriate spaces on Work Sheet I.

ii. Multiply each upward utilization factor by the per cent of lamp luments emitted upward by the luminaire (obtained from heading of Work Sheet I). These results are the Upward Coefficients.

**Step 3.**

Add the Downward Coefficient (Step 1g) and the Upward Coefficients (Step 2a,v or 2b,ii) for each value of room ratio and ceiling and wall reflectance. The results are the Coefficients of Utilization for a luminaire that emits both upward and downward light.

## WORK SHEET FOR COMPUTING

LUMINAIRE DESCRIPTION_____
TOTAL RATED LAMP LUMENS_____
0°-90° LUMENS_____
90°-180° LUMENS_____

| ROOM RATIO | ROOM INDEX | FOR DOWN COLUMNS | FLOOR REFLECTANCE_____ CEILING REFLECTANCE_____ | | | | | | FLOOR REFLECTANCE_____ CEILING REFLECTANCE_____ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 50% WALLS | | 30% WALLS | | 10% WALLS | | 50% WALLS | | 30% WALLS | | 10% WALLS | |
| | | | DOWN | UP | DOWN | UP | DOWN | UP | DOWN | UP | DOWN | UP | DOWN | UP |
| 0.6 | J | DR | | | | | | | | | | | | |
| | | DRC | | | | | | | | | | | | |
| | | SUM | | | | | | | | | | | | |
| | | DC | | | | | | | | | | | | |
| 0.8 | I | DR | | | | | | | | | | | | |
| | | DRC | | | | | | | | | | | | |
| | | SUM | | | | | | | | | | | | |
| | | DC | | | | | | | | | | | | |
| 1.0 | H | DR | | | | | | | | | | | | |
| | | DRC | | | | | | | | | | | | |
| | | SUM | | | | | | | | | | | | |
| | | DC | | | | | | | | | | | | |
| 1.25 | G | DR | | | | | | | | | | | | |
| | | DRC | | | | | | | | | | | | |
| | | SUM | | | | | | | | | | | | |
| | | DC | | | | | | | | | | | | |
| 1.5 | F | DR | | | | | | | | | | | | |
| | | DRC | | | | | | | | | | | | |
| | | SUM | | | | | | | | | | | | |
| | | DC | | | | | | | | | | | | |
| 2.0 | E | DR | | | | | | | | | | | | |
| | | DRC | | | | | | | | | | | | |
| | | SUM | | | | | | | | | | | | |
| | | DC | | | | | | | | | | | | |
| 2.5 | D | DR | | | | | | | | | | | | |
| | | DRC | | | | | | | | | | | | |
| | | SUM | | | | | | | | | | | | |
| | | DC | | | | | | | | | | | | |
| 3.0 | C | DR | | | | | | | | | | | | |
| | | DRC | | | | | | | | | | | | |
| | | SUM | | | | | | | | | | | | |
| | | DC | | | | | | | | | | | | |
| 4.0 | B | DR | | | | | | | | | | | | |
| | | DRC | | | | | | | | | | | | |
| | | SUM | | | | | | | | | | | | |
| | | DC | | | | | | | | | | | | |
| 5.0 | A | DR | | | | | | | | | | | | |
| | | DRC | | | | | | | | | | | | |
| | | SUM | | | | | | | | | | | | |
| | | DC | | | | | | | | | | | | |

DR = DIRECT RATIO, THE PERCENT (EXPRESSED AS A DECIMAL) OF 0° TO 90° LUMINAIRE LUMENS THAT STRIKE THE WORK
DRC = DOWNWARD REFLECTED COMPONENT, THE PERCENT (EXPRESSED AS A DECIMAL) OF 0° TO 90° LUMINAIRE LUMENS THAT
DC = DOWNWARD COEFFICIENT, (DR + DRC) (0° TO 90° LUMINAIRE LUMENS ÷ LAMP LUMENS).
UUF = UPWARD UTILIZATION FACTOR, THE PERCENT (EXPRESSED AS A DECIMAL) OF 90° TO 180° LUMINAIRE LUMENS THAT
UC = UPWARD COEFFICIENT, (UUF) (90° TO 180° LUMINAIRE LUMENS ÷ LAMP LUMENS).
CU = COEFFICIENT OF UTILIZATION, DC + UC.

## COEFFICIENTS OF UTILIZATION

WORK SHEET 1.

0°-90° LUMENS÷TOTAL RATED LAMP LUMENS_____
90°-180° LUMENS÷TOTAL RATED LAMP LUMENS_____
RECOMMENDED MAXIMUM SPACING-TO-MOUNTING-HEIGHT RATIO_____

| FLOOR REFLECTANCE_____ CEILING REFLECTANCE_____ | | | | | | FLOOR REFLECTANCE_____ CEILING REFLECTANCE_____ | | | | | | FOR UP COLUMNS | CEILING RATIO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 50% WALLS | | 30% WALLS | | 10% WALLS | | 50% WALLS | | 30% WALLS | | 10% WALLS | | | |
| DOWN | UP | DOWN | UP | DOWN | UP | DOWN | UP | DOWN | UP | DOWN | UP | | |
| | | | | | | | | | | | | UUF | |
| | | | | | | | | | | | | UC DC | |
| | | | | | | | | | | | | CU | |
| | | | | | | | | | | | | UUF | |
| | | | | | | | | | | | | UC DC | |
| | | | | | | | | | | | | CU | |
| | | | | | | | | | | | | UUF | |
| | | | | | | | | | | | | UC DC | |
| | | | | | | | | | | | | CU | |
| | | | | | | | | | | | | UUF | |
| | | | | | | | | | | | | UC DC | |
| | | | | | | | | | | | | CU | |
| | | | | | | | | | | | | UUF | |
| | | | | | | | | | | | | UC DC | |
| | | | | | | | | | | | | CU | |
| | | | | | | | | | | | | UUF | |
| | | | | | | | | | | | | UC DC | |
| | | | | | | | | | | | | CU | |
| | | | | | | | | | | | | UUF | |
| | | | | | | | | | | | | UC DC | |
| | | | | | | | | | | | | CU | |
| | | | | | | | | | | | | UUF | |
| | | | | | | | | | | | | UC DC | |
| | | | | | | | | | | | | CU | |
| | | | | | | | | | | | | UUF | |
| | | | | | | | | | | | | UC DC | |
| | | | | | | | | | | | | CU | |

PLANE DIRECTLY.
ARE REFLECTED FROM THE ROOM SURFACES TO THE WORK PLANE.

ARE REFLECTED BY THE ROOM SURFACES TO THE WORK PLANE.

WORK SHEET II a

**Computing Direct Ratios (Spacing-to-Mounting Height Ratio = 1.0)**

**Luminaire Description**_____

| | ROOM RATIO | 0.6 | | 0.8 | | 1.0 | | 1.25 | | 1.5 | | 2.0 | | 2.5 | | 3.0 | | 4.0 | | 5.0 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ROOM INDEX | J | | I | | H | | G | | F | | E | | D | | C | | B | | A | |
| ZONE (DEG.) | LUMINAIRE LUMENS | ZONAL MULTIPLIERS 0° TO 90° | | | | | | | | | | | | | | | | | | | |
| 0-10 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | |
| 10-20 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | |
| 20-30 | | .86 | | .90 | | .92 | | .94 | | .95 | | .96 | | .97 | | .97 | | .98 | | .98 | |
| 30-40 | | .21 | | .40 | | .52 | | .61 | | .68 | | .76 | | .81 | | .84 | | .88 | | .90 | |
| 40-50 | | .14 | | .32 | | .43 | | .53 | | .60 | | .70 | | .75 | | .79 | | .84 | | .87 | |
| 50-60 | | — | | .13 | | .27 | | .39 | | .48 | | .60 | | .67 | | .72 | | .80 | | .83 | |
| 60-70 | | — | | — | | .02 | | .13 | | .24 | | .40 | | .51 | | .58 | | .68 | | .74 | |
| 70-80 | | — | | — | | — | | — | | .01 | | .09 | | .20 | | .31 | | .46 | | .55 | |
| 80-90 | | — | | — | | — | | — | | — | | — | | — | | .01 | | .05 | | .10 | |
| TOTAL | | | | | | | | | | | | | | | | | | | | | |
| DIRECT RATIO | | | | | | | | | | | | | | | | | | | | | |

WORK SHEET II b

**Computing Direct Ratios (Spacing-to-Mounting Height Ratio = 0.9)**

**Luminaire Description**_____

| | ROOM RATIO | 0.6 | | 0.8 | | 1.0 | | 1.25 | | 1.5 | | 2.0 | | 2.5 | | 3.0 | | 4.0 | | 5.0 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ROOM INDEX | J | | I | | H | | G | | F | | E | | D | | C | | B | | A | |
| ZONE (DEG.) | LUMINAIRE LUMENS | ZONAL MULTIPLIERS 0° TO 90° | | | | | | | | | | | | | | | | | | | |
| 0-10 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | |
| 10-20 | | .95 | | .96 | | .97 | | .98 | | .98 | | .98 | | .99 | | .99 | | .99 | | .99 | |
| 20-30 | | .81 | | .86 | | .89 | | .91 | | .93 | | .95 | | .96 | | .96 | | .97 | | .97 | |
| 30-40 | | .23 | | .42 | | .53 | | .61 | | .68 | | .76 | | .81 | | .84 | | .88 | | .90 | |
| 40-50 | | .14 | | .33 | | .44 | | .54 | | .61 | | .70 | | .76 | | .79 | | .84 | | .87 | |
| 50-60 | | — | | .13 | | .27 | | .39 | | .48 | | .60 | | .67 | | .72 | | .80 | | .83 | |
| 60-70 | | — | | — | | .02 | | .14 | | .25 | | .41 | | .51 | | .58 | | .68 | | .75 | |
| 70-80 | | — | | — | | — | | — | | .01 | | .09 | | .20 | | .31 | | .46 | | .56 | |
| 80-90 | | — | | — | | — | | — | | — | | — | | — | | .01 | | .05 | | .11 | |
| TOTAL | | | | | | | | | | | | | | | | | | | | | |
| DIRECT RATIO | | | | | | | | | | | | | | | | | | | | | |

WORK SHEET II c

**Computing Direct Ratios (Spacing -to-Mounting Height Ratio = 0.8)**

**Luminaire Description**_____

| ZONE (DEG.) | ROOM RATIO | 0.6 | | 0.8 | | 1.0 | | 1.25 | | 1.5 | | 2.0 | | 2.5 | | 3.0 | | 4.0 | | 5.0 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ROOM INDEX | J | | I | | H | | G | | F | | E | | D | | C | | B | | A | |
| | LUMINAIRE LUMENS | ZONAL MULTIPLIERS 0° TO 90° | | | | | | | | | | | | | | | | | | | |
| 0-10 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | |
| 10-20 | | .91 | | .93 | | .94 | | .95 | | .96 | | .97 | | .97 | | .98 | | .98 | | .99 | |
| 20-30 | | .76 | | .82 | | .86 | | .89 | | .91 | | .93 | | .94 | | .95 | | .96 | | .97 | |
| 30-40 | | .25 | | .43 | | .53 | | .62 | | .68 | | .76 | | .81 | | .84 | | .88 | | .90 | |
| 40-50 | | .15 | | .33 | | .45 | | .54 | | .61 | | .71 | | .76 | | .80 | | .85 | | .87 | |
| 50-60 | | .01 | | .13 | | .27 | | .39 | | .48 | | .60 | | .67 | | .72 | | .79 | | .83 | |
| 60-70 | | — | | — | | .03 | | .16 | | .26 | | .41 | | .51 | | .58 | | .68 | | .75 | |
| 70-80 | | — | | — | | — | | — | | .01 | | .10 | | .21 | | .31 | | .46 | | .57 | |
| 80-90 | | — | | — | | — | | — | | — | | — | | — | | .01 | | .05 | | .11 | |
| TOTAL | | | | | | | | | | | | | | | | | | | | | |
| DIRECT RATIO | | | | | | | | | | | | | | | | | | | | | |

WORK SHEET II d

**Computing Direct Ratios (Spacing-to-Mounting Height Ratio = 0.7)**

**Luminaire Description**_____

| ZONE (DEG.) | ROOM RATIO | 0.6 | | 0.8 | | 1.0 | | 1.25 | | 1.5 | | 2.0 | | 2.5 | | 3.0 | | 4.0 | | 5.0 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ROOM INDEX | J | | I | | H | | G | | F | | E | | D | | C | | B | | A | |
| | LUMINAIRE LUMENS | ZONAL MULTIPLIERS 0° TO 90° | | | | | | | | | | | | | | | | | | | |
| 0-10 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | |
| 10-20 | | .86 | | .90 | | .91 | | .93 | | .94 | | .96 | | .96 | | .97 | | .98 | | .98 | |
| 20-30 | | .72 | | .79 | | .83 | | .87 | | .89 | | .92 | | .93 | | .94 | | .96 | | .96 | |
| 30-40 | | .28 | | .45 | | .54 | | .63 | | .69 | | .77 | | .82 | | .85 | | .88 | | .91 | |
| 40-50 | | .15 | | .24 | | .46 | | .55 | | .62 | | .71 | | .77 | | .81 | | .85 | | .88 | |
| 50-60 | | .02 | | .13 | | .28 | | .39 | | .48 | | .60 | | .67 | | .72 | | .79 | | .83 | |
| 60-70 | | — | | — | | .04 | | .17 | | .28 | | .42 | | .52 | | .59 | | .69 | | .76 | |
| 70-80 | | — | | — | | — | | — | | — | | .10 | | .21 | | .32 | | .47 | | .58 | |
| 80-90 | | — | | — | | — | | — | | — | | — | | — | | — | | .05 | | .12 | |
| TOTAL | | | | | | | | | | | | | | | | | | | | | |
| DIRECT RATIO | | | | | | | | | | | | | | | | | | | | | |

WORK SHEET IIe

**Computing Direct Ratios (Spacing-to-Mounting Height Ratio = 0.6)**

**Luminaire Description**_____

| ZONE (DEG.) | ROOM RATIO | 0.6 | | 0.8 | | 1.0 | | 1.25 | | 1.5 | | 2.0 | | 2.5 | | 3.0 | | 4.0 | | 5.0 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ROOM INDEX | J | | I | | H | | G | | F | | E | | D | | C | | B | | A | |
| | LUMINAIRE LUMENS | ZONAL MULTIPLIERS 0° TO 90° | | | | | | | | | | | | | | | | | | | |
| 0-10 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | |
| 10-20 | | .81 | | .86 | | .87 | | .90 | | .92 | | .94 | | .95 | | .96 | | .97 | | .97 | |
| 20-30 | | .67 | | .75 | | .79 | | .84 | | .87 | | .90 | | .92 | | .93 | | .95 | | .95 | |
| 30-40 | | .30 | | .47 | | .55 | | .65 | | .69 | | .77 | | .82 | | .85 | | .88 | | .91 | |
| 40-50 | | .15 | | .35 | | .47 | | .56 | | .63 | | .71 | | .77 | | .81 | | .85 | | .88 | |
| 50-60 | | .02 | | .12 | | .28 | | .39 | | .48 | | .60 | | .67 | | .72 | | .79 | | .83 | |
| 60-70 | | — | | — | | .04 | | .18 | | .29 | | .42 | | .52 | | .59 | | .69 | | .76 | |
| 70-80 | | — | | — | | — | | — | | — | | .10 | | .21 | | .32 | | .47 | | .58 | |
| 80-90 | | — | | — | | — | | — | | — | | — | | — | | — | | .04 | | .13 | |
| TOTAL | | | | | | | | | | | | | | | | | | | | | |
| DIRECT RATIO | | | | | | | | | | | | | | | | | | | | | |

WORK SHEET IIf

**Computing Direct Ratios (Spacing-to-Mounting Height Ratio = 0.4)**

**Luminaire Description**_____

| ZONE (DEG.) | ROOM RATIO | 0.6 | | 0.8 | | 1.0 | | 1.25 | | 1.5 | | 2.0 | | 2.5 | | 3.0 | | 4.0 | | 5.0 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ROOM INDEX | J | | I | | H | | G | | F | | E | | D | | C | | B | | A | |
| | LUMINAIRE LUMENS | ZONAL MULTIPLIERS 0° TO 90° | | | | | | | | | | | | | | | | | | | |
| 0-10 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | |
| 10-20 | | .72 | | .79 | | .81 | | .85 | | .88 | | .91 | | .92 | | .94 | | .95 | | .96 | |
| 20-30 | | .57 | | .67 | | .73 | | .79 | | .83 | | .87 | | .89 | | .91 | | .93 | | .94 | |
| 30-40 | | .34 | | .50 | | .56 | | .64 | | .69 | | .77 | | .82 | | .85 | | .88 | | .91 | |
| 40-50 | | .16 | | .36 | | .49 | | .57 | | .64 | | .72 | | .78 | | .81 | | .86 | | .88 | |
| 50-60 | | .03 | | .12 | | .28 | | .39 | | .48 | | .60 | | .67 | | .72 | | .78 | | .83 | |
| 60-70 | | — | | — | | .05 | | .21 | | .31 | | .43 | | .52 | | .59 | | .69 | | .77 | |
| 70-80 | | — | | — | | — | | — | | — | | .11 | | .22 | | .32 | | .47 | | .60 | |
| 80-90 | | — | | — | | — | | — | | — | | — | | — | | — | | .04 | | .14 | |
| TOTAL | | | | | | | | | | | | | | | | | | | | | |
| DIRECT RATIO | | | | | | | | | | | | | | | | | | | | | |

WORK SHEET III

## Work Sheet for Computing Ceiling Ratio

**Luminaire Description**_____

| ZONE (DEG.) | ROOM RATIO | 0.6 | | 0.8 | | 1.0 | | 1.25 | | 1.5 | | 2.0 | | 2.5 | | 3.0 | | 4.0 | | 5.0 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ROOM INDEX | J | | I | | H | | G | | F | | E | | D | | C | | B | | A | |
| | LUMINAIRE LUMENS | ZONAL MULTIPLIERS 90° TO 180° | | | | | | | | | | | | | | | | | | | |
| 90-100 | | — | | — | | — | | — | | — | | .04 | | .14 | | .22 | | .33 | | .40 | |
| 100-110 | | — | | — | | .10 | | .22 | | .32 | | .47 | | .60 | | .67 | | .76 | | .81 | |
| 110-120 | | .20 | | .34 | | .43 | | .52 | | .59 | | .69 | | .77 | | .82 | | .89 | | .93 | |
| 120-130 | | .37 | | .50 | | .60 | | .67 | | .72 | | .78 | | .83 | | .88 | | .91 | | .94 | |
| 130-140 | | .56 | | .66 | | .72 | | .78 | | .81 | | .86 | | .88 | | .91 | | .94 | | .95 | |
| 140-150 | | .63 | | .71 | | .77 | | .82 | | .85 | | .88 | | .91 | | .94 | | .96 | | .97 | |
| 150-180 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 | |
| TOTAL | | | | | | | | | | | | | | | | | | | | | |
| CEILING RATIO | | | | | | | | | | | | | | | | | | | | | |

Figure 1a. Downward Reflected Component, Ceiling Mounted Luminaires.

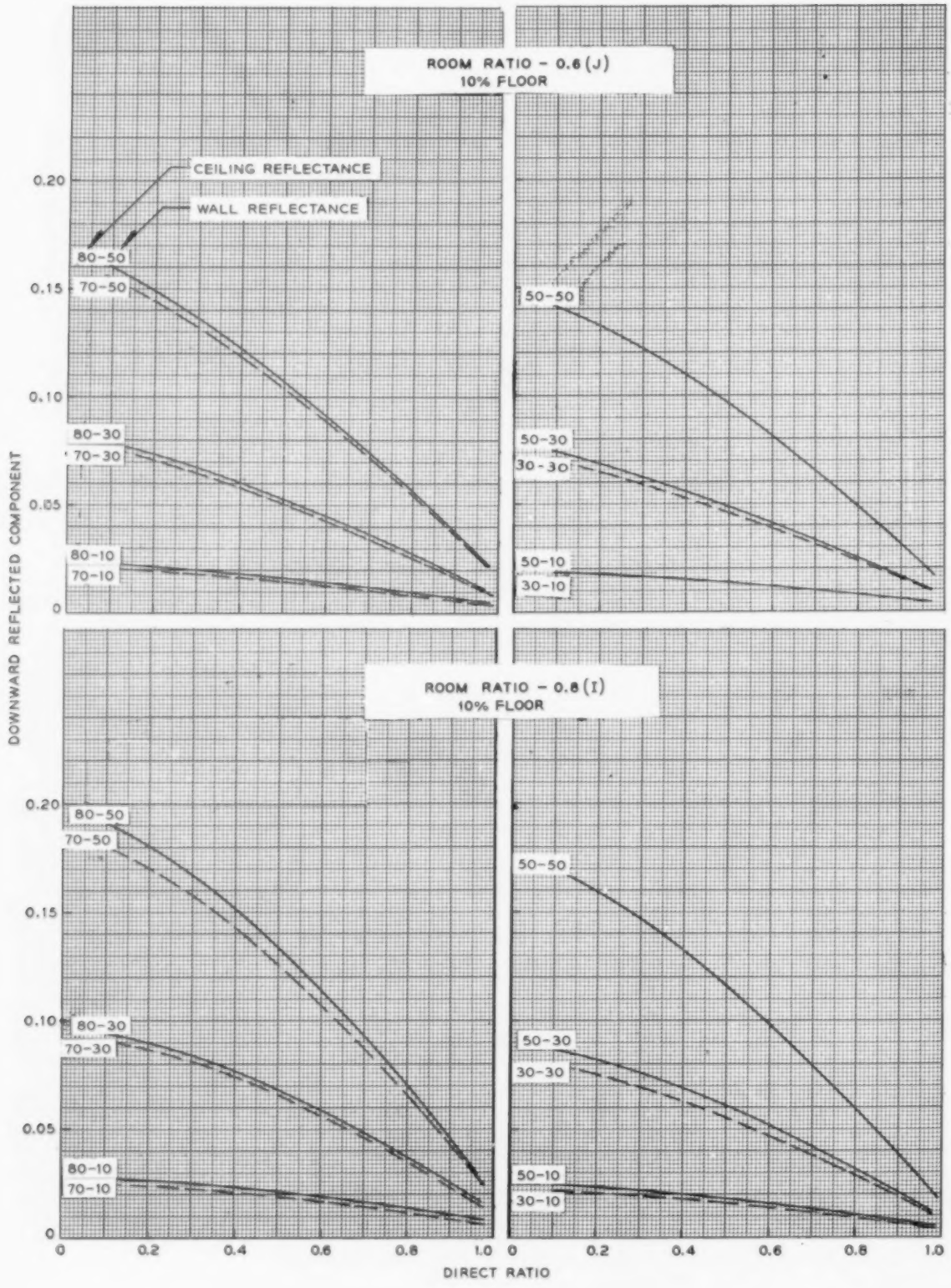


Figure 1a. Downward Reflected Component, Ceiling Mounted Luminaires.

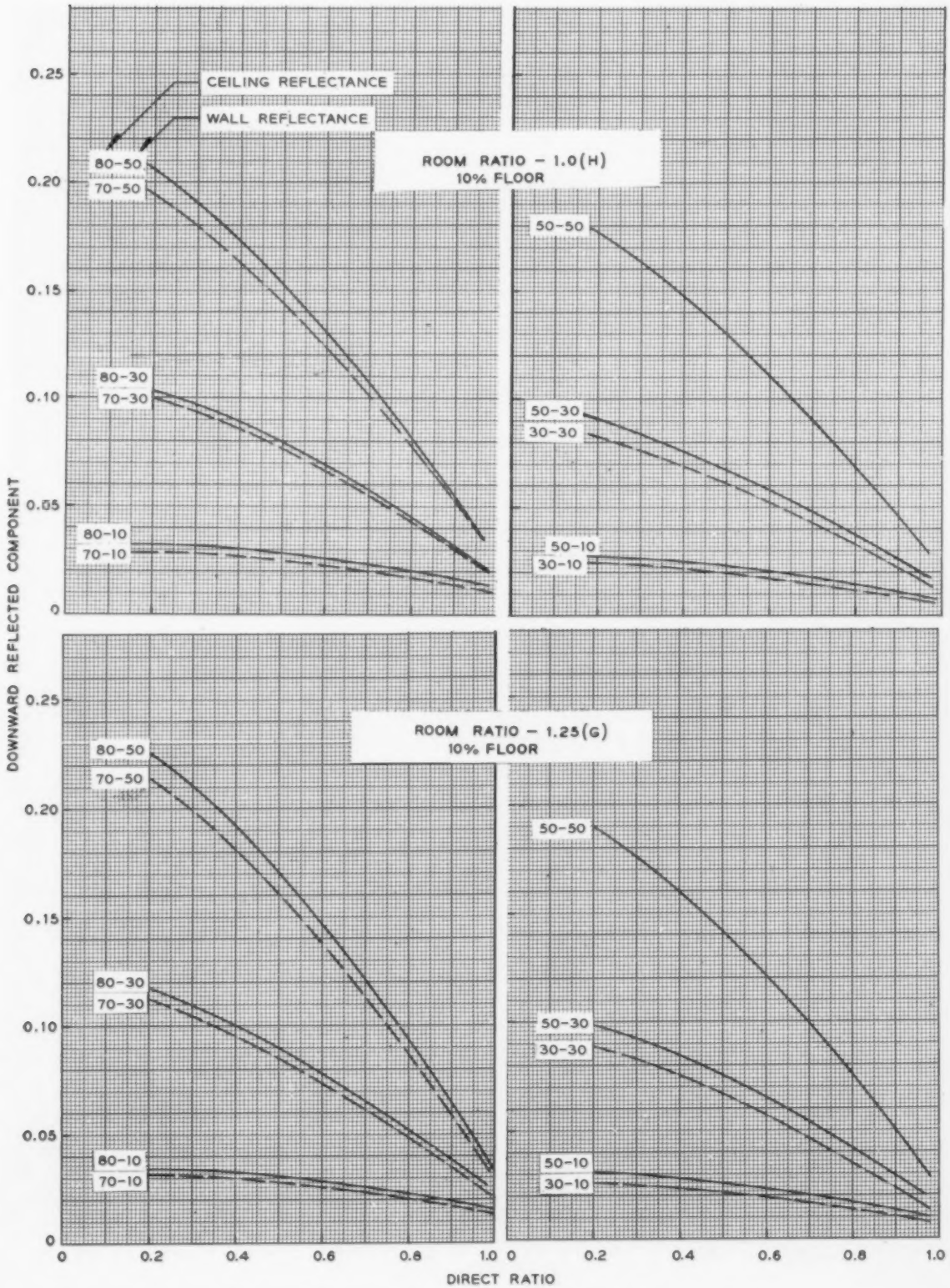


Figure 1a. Downward Reflected Component, Ceiling Mounted Luminaires.

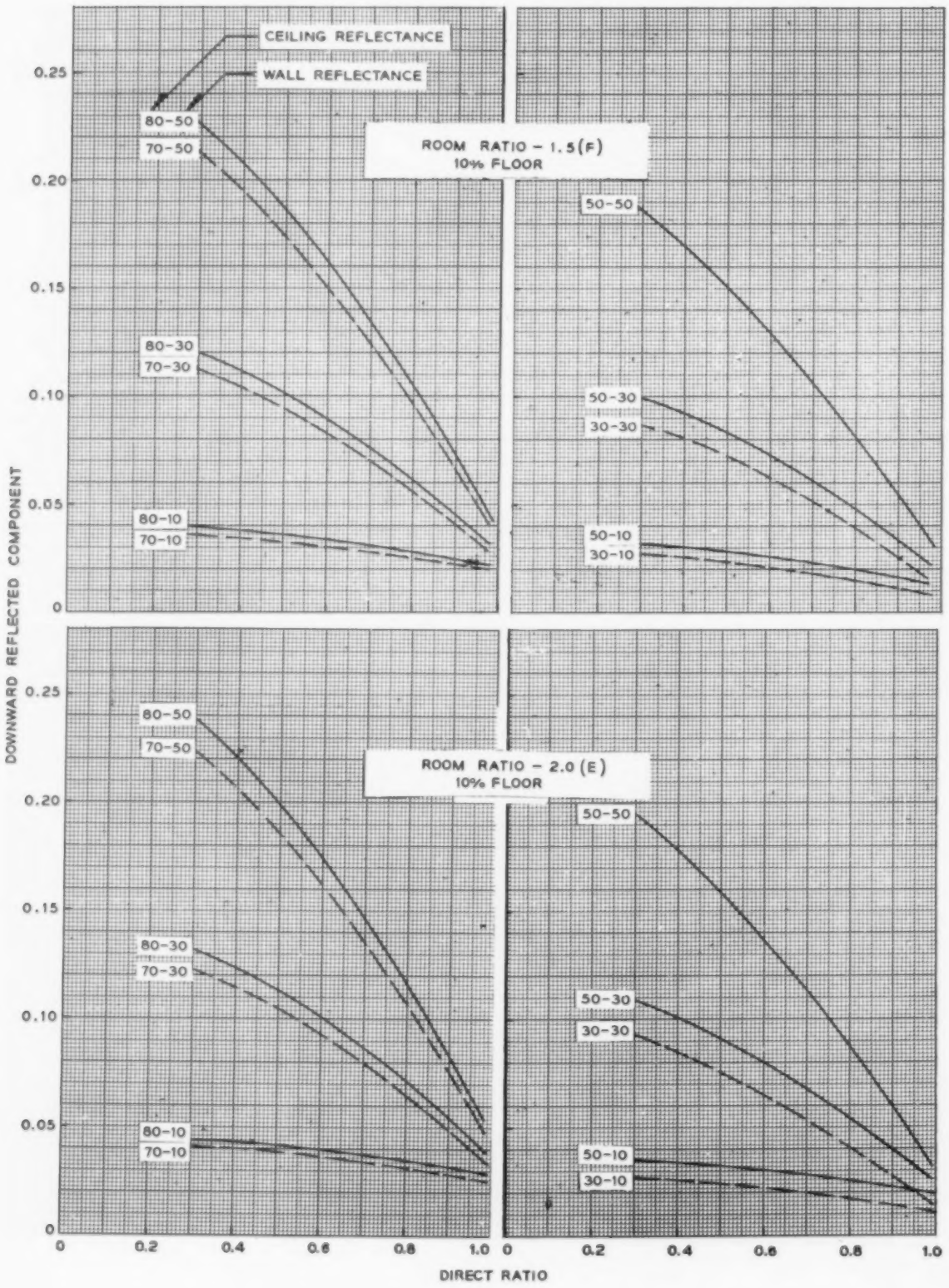


Figure 1a. Downward Reflected Component, Ceiling Mounted Luminaires.

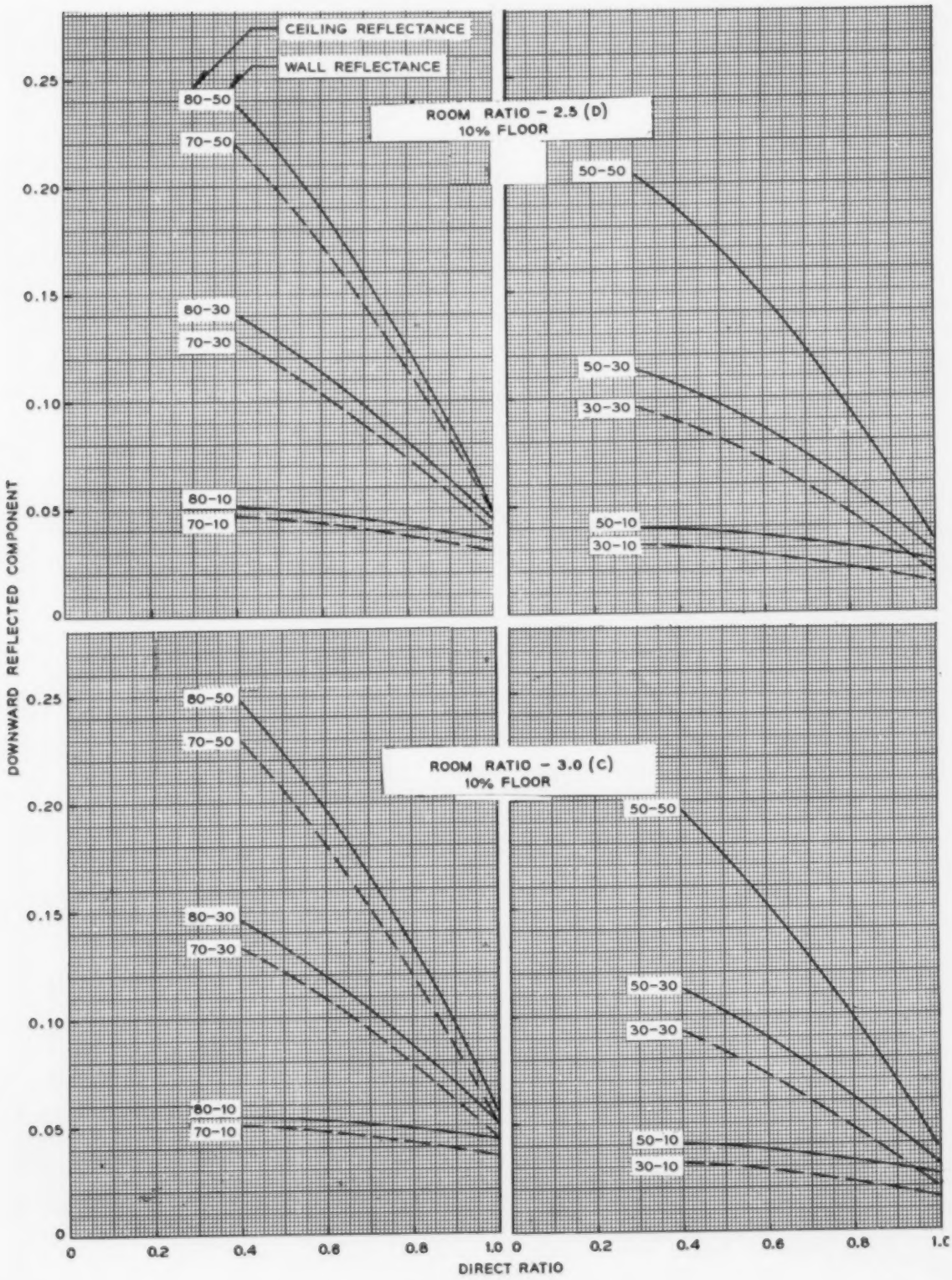


Figure 1a. Downward Reflected Component, Ceiling Mounted Luminaires.

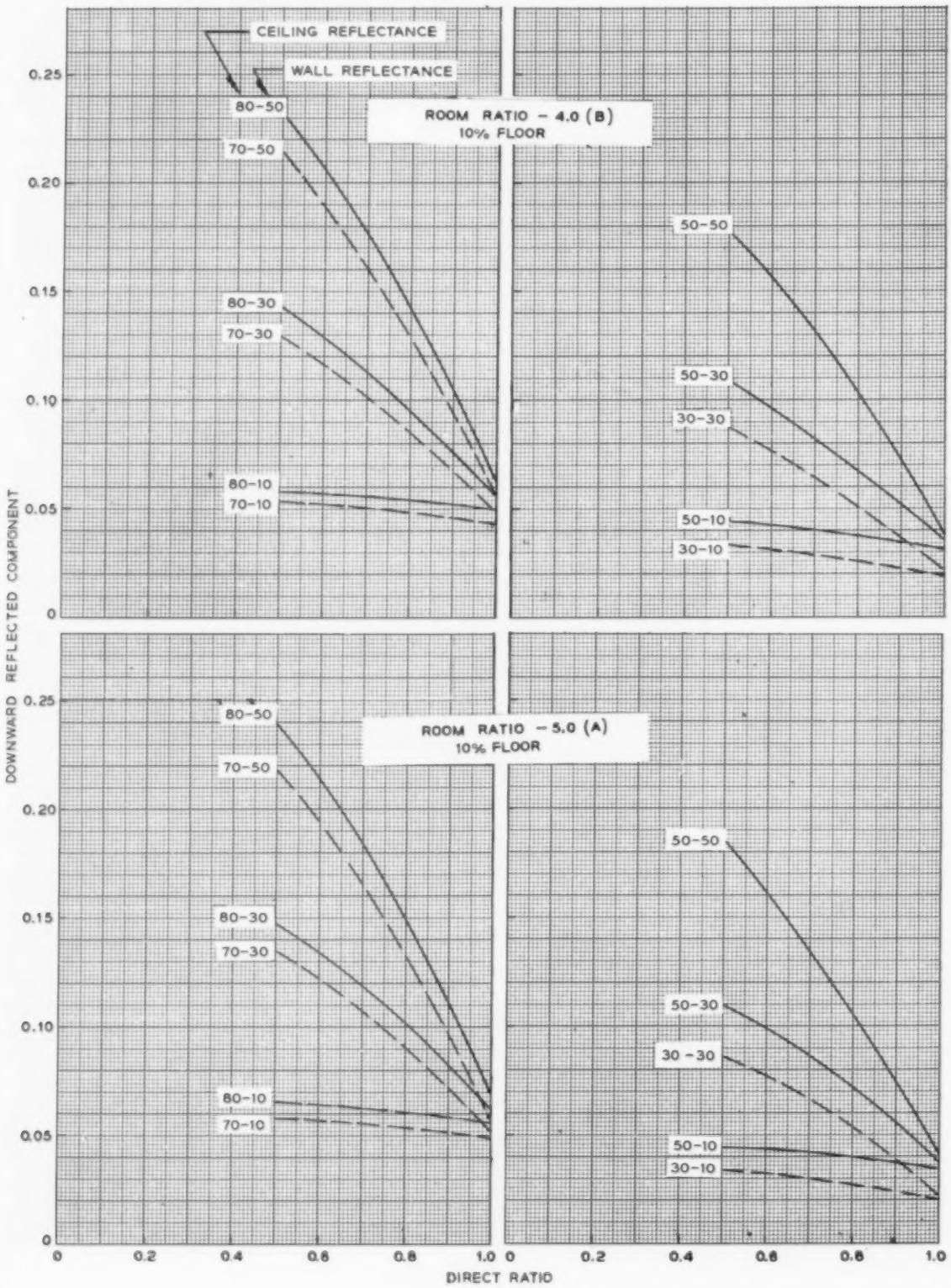


Figure 1b. Downward Reflected Component, Ceiling Mounted Luminaires.

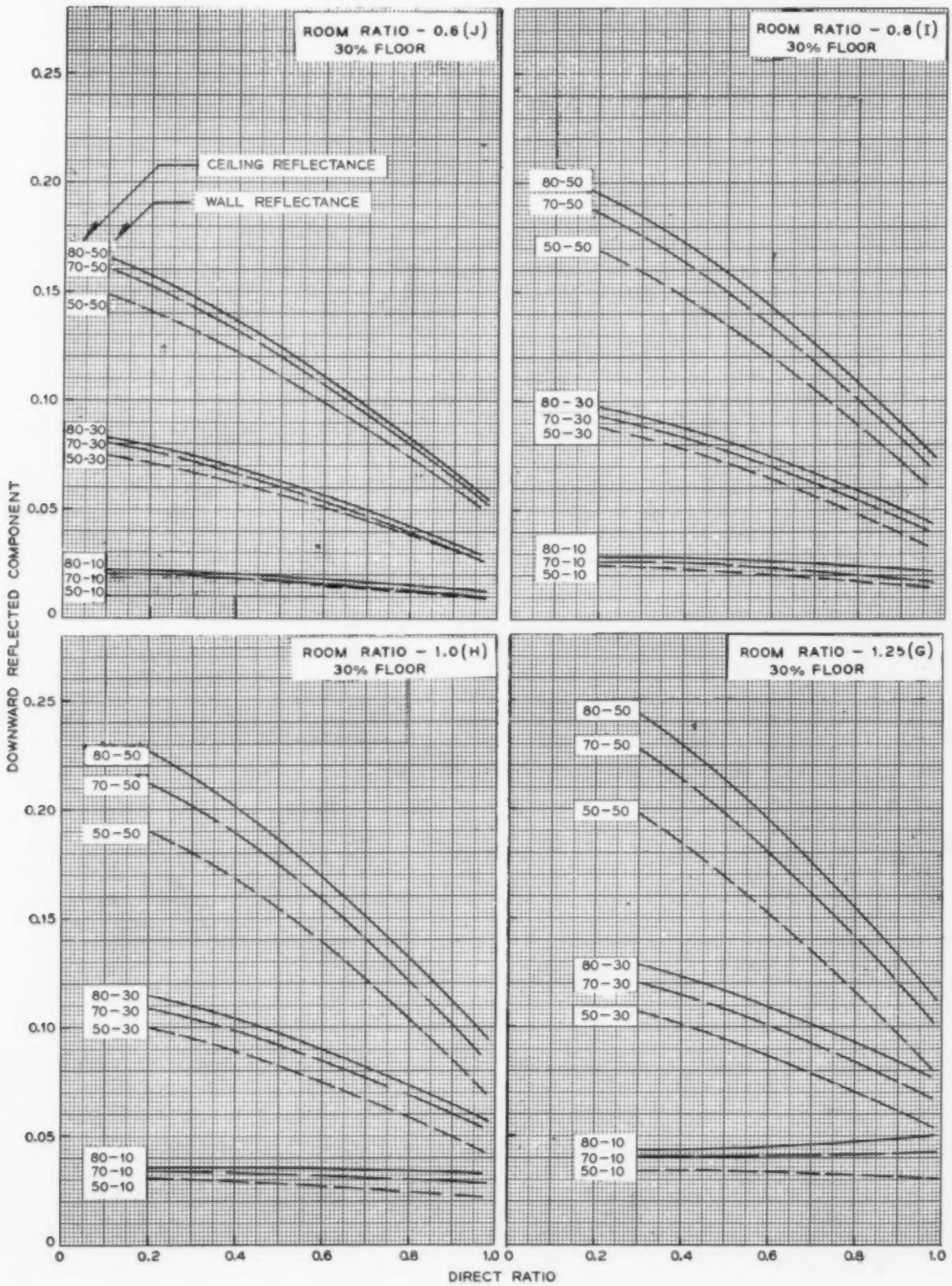


Figure 1b. Downward Reflected Component, Ceiling Mounted Luminaires.

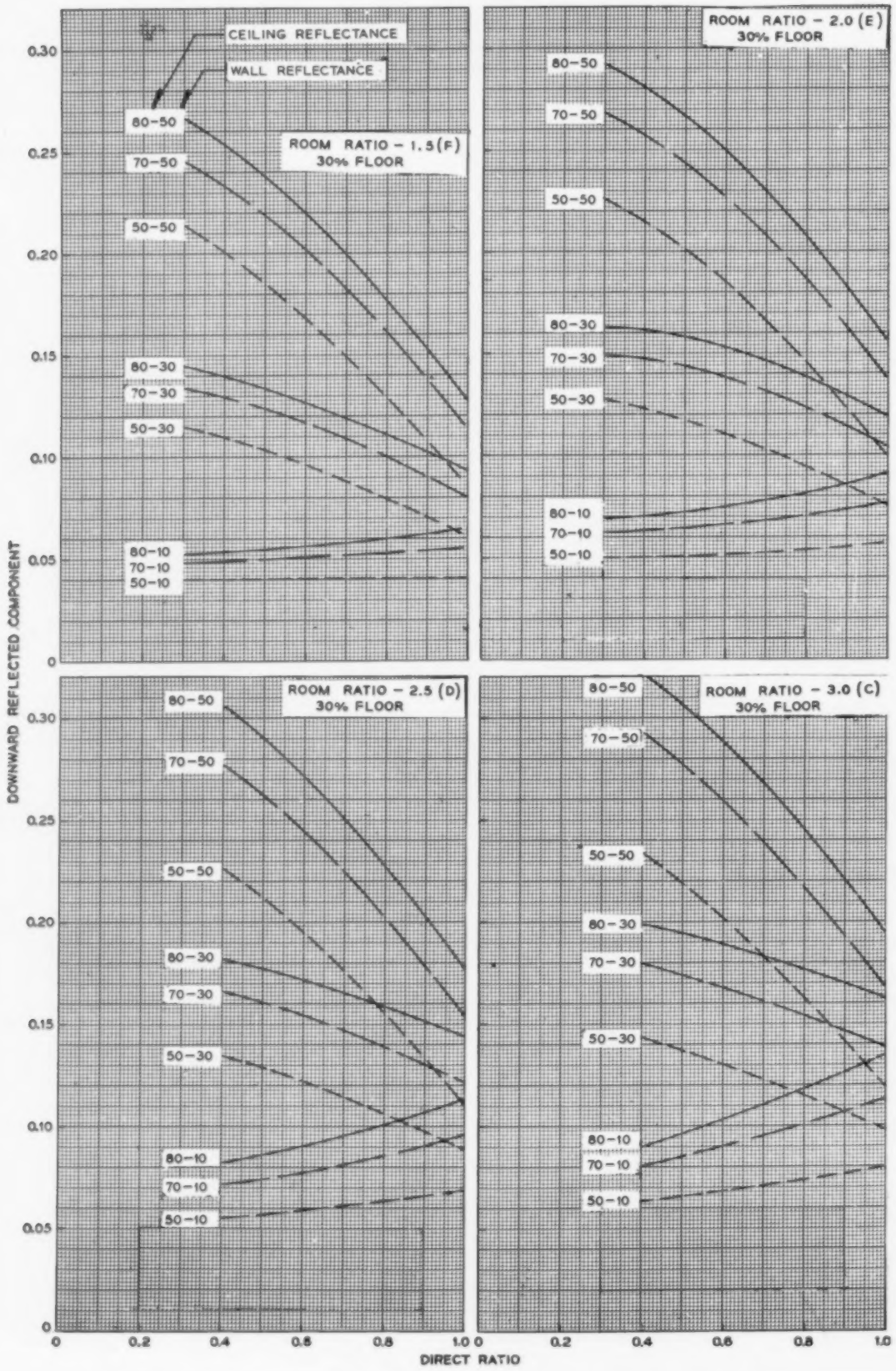


Figure 1b. Downward Reflected Component, Ceiling Mounted Luminaires.

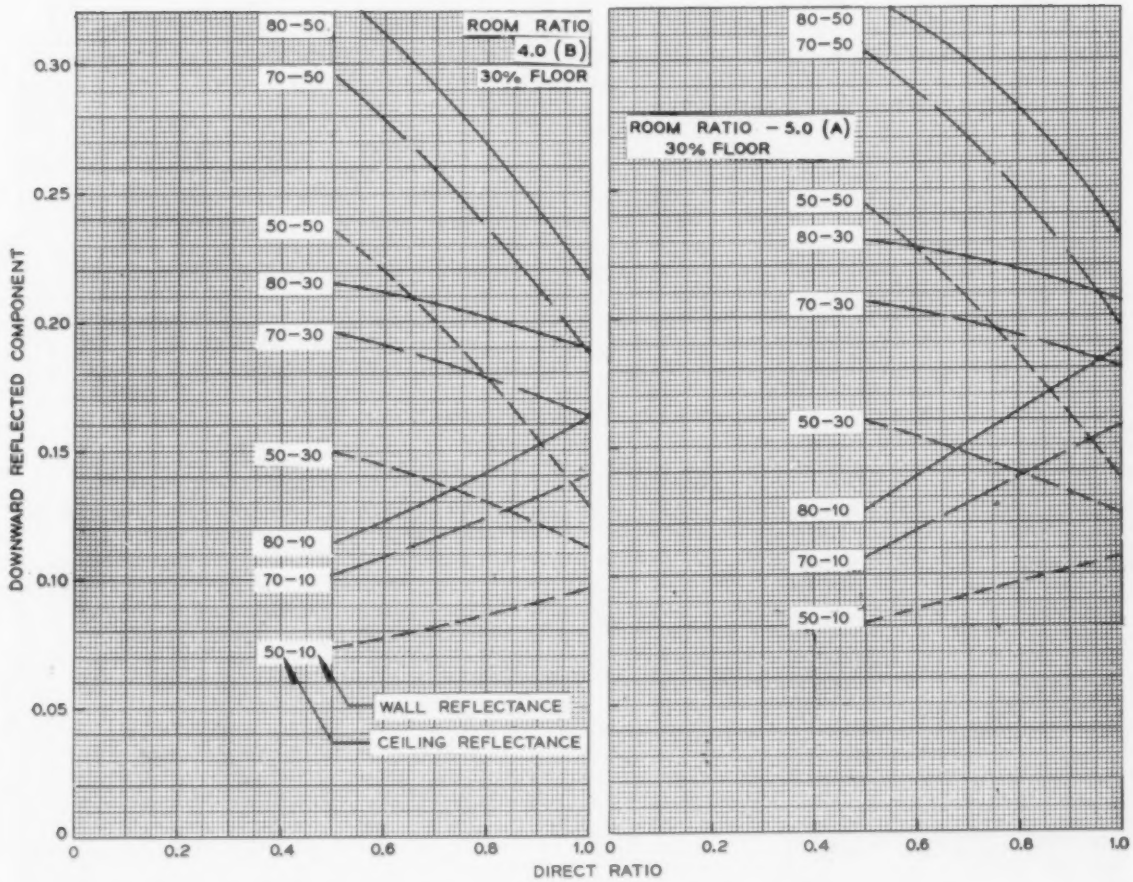


Figure 2a. Downward Reflected Component, Suspended Luminaires.

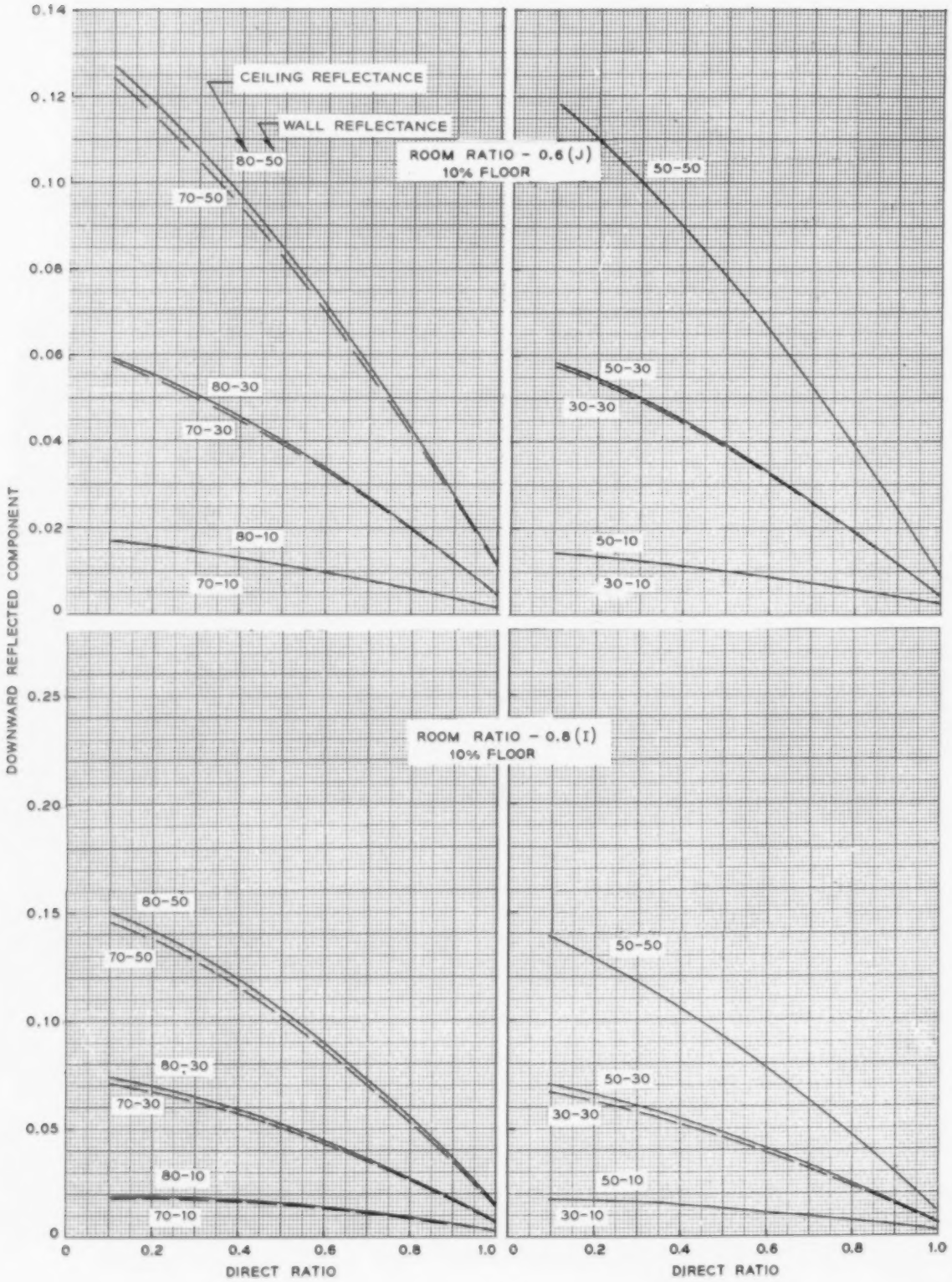


Figure 2a. Downward Reflected Component, Suspended Luminaires.

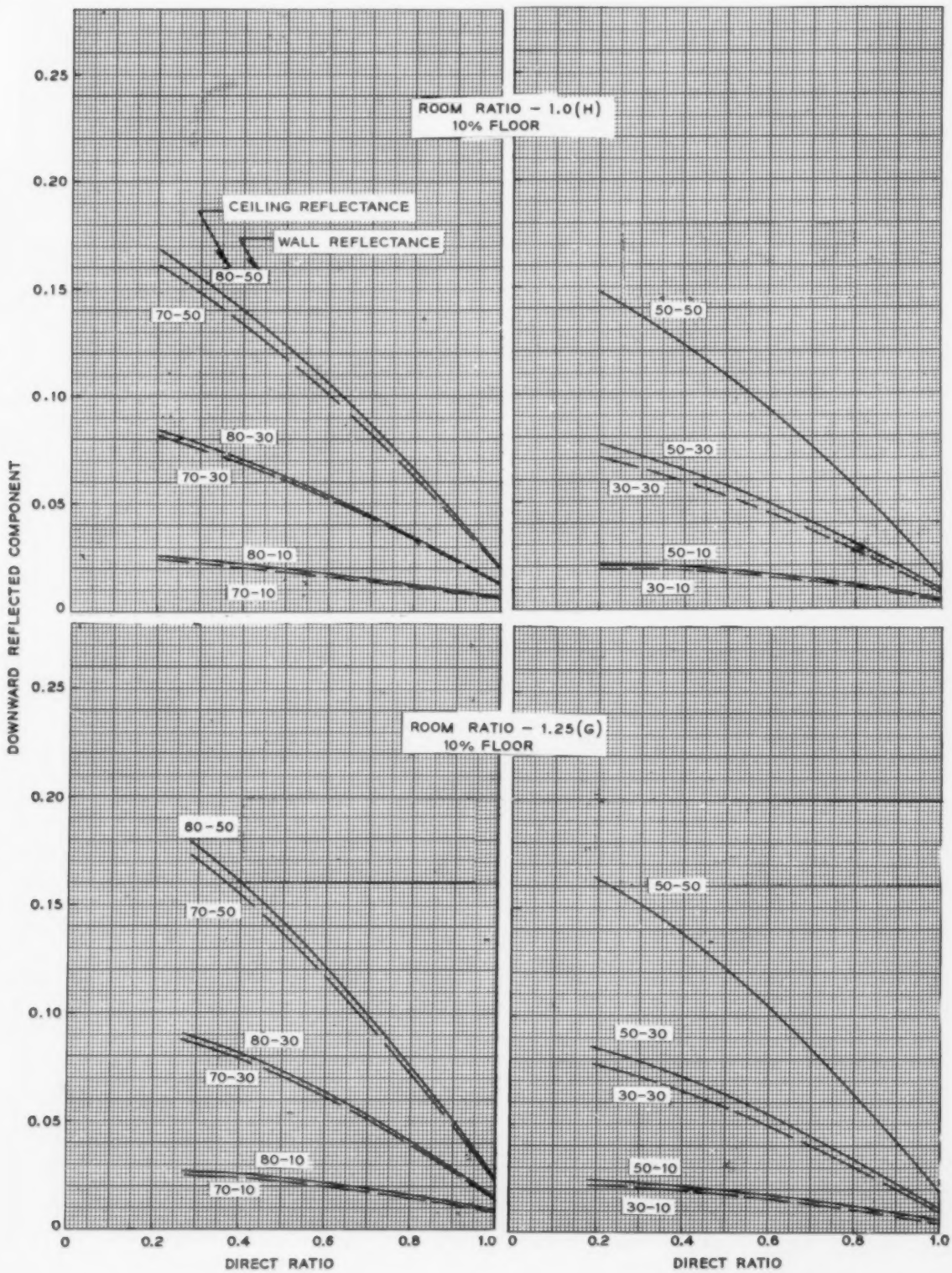


Figure 2a. Downward Reflected Component, Suspended Luminaires.

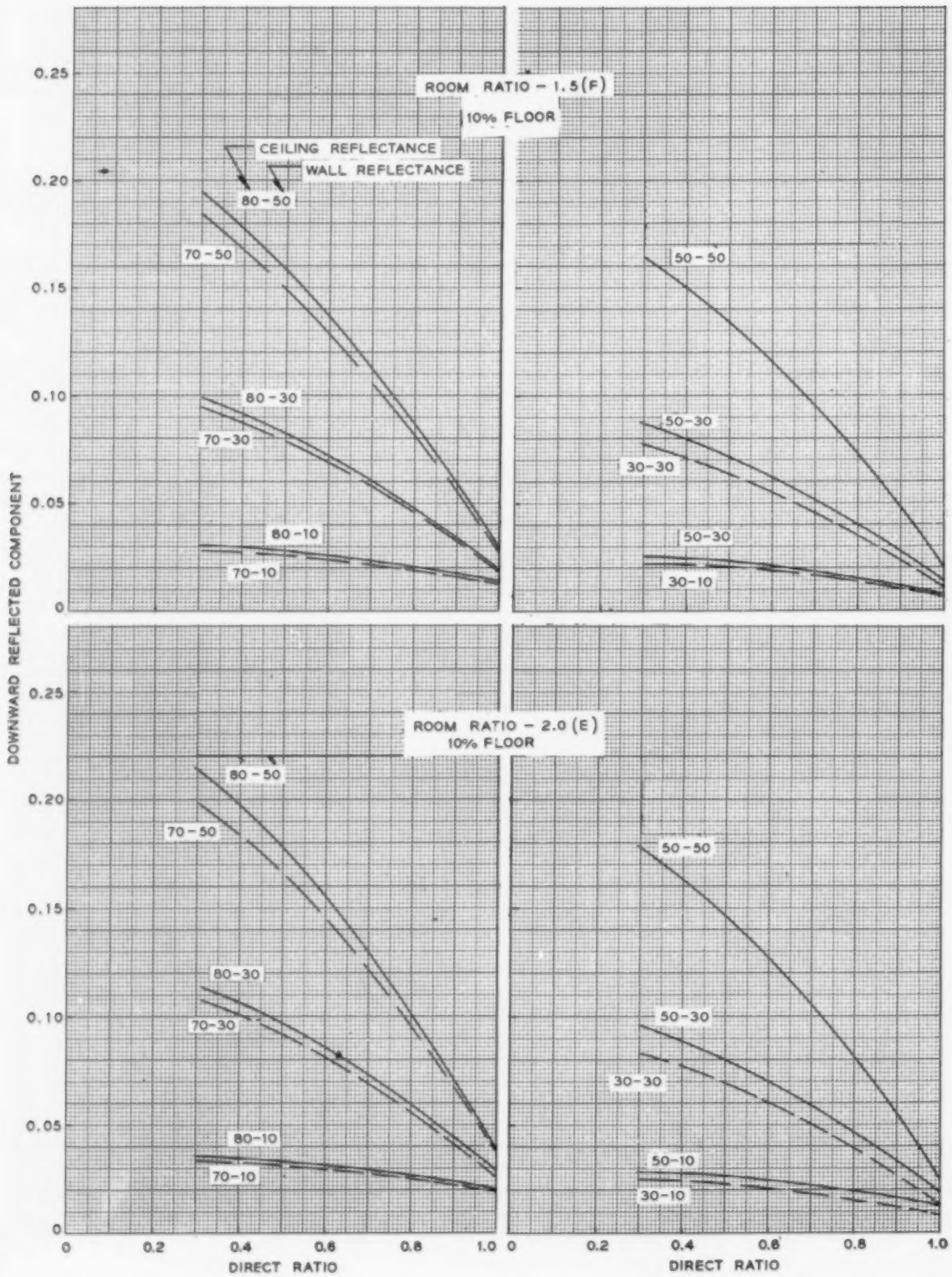


Figure 2a. Downward Reflected Component, Suspended Luminaires.

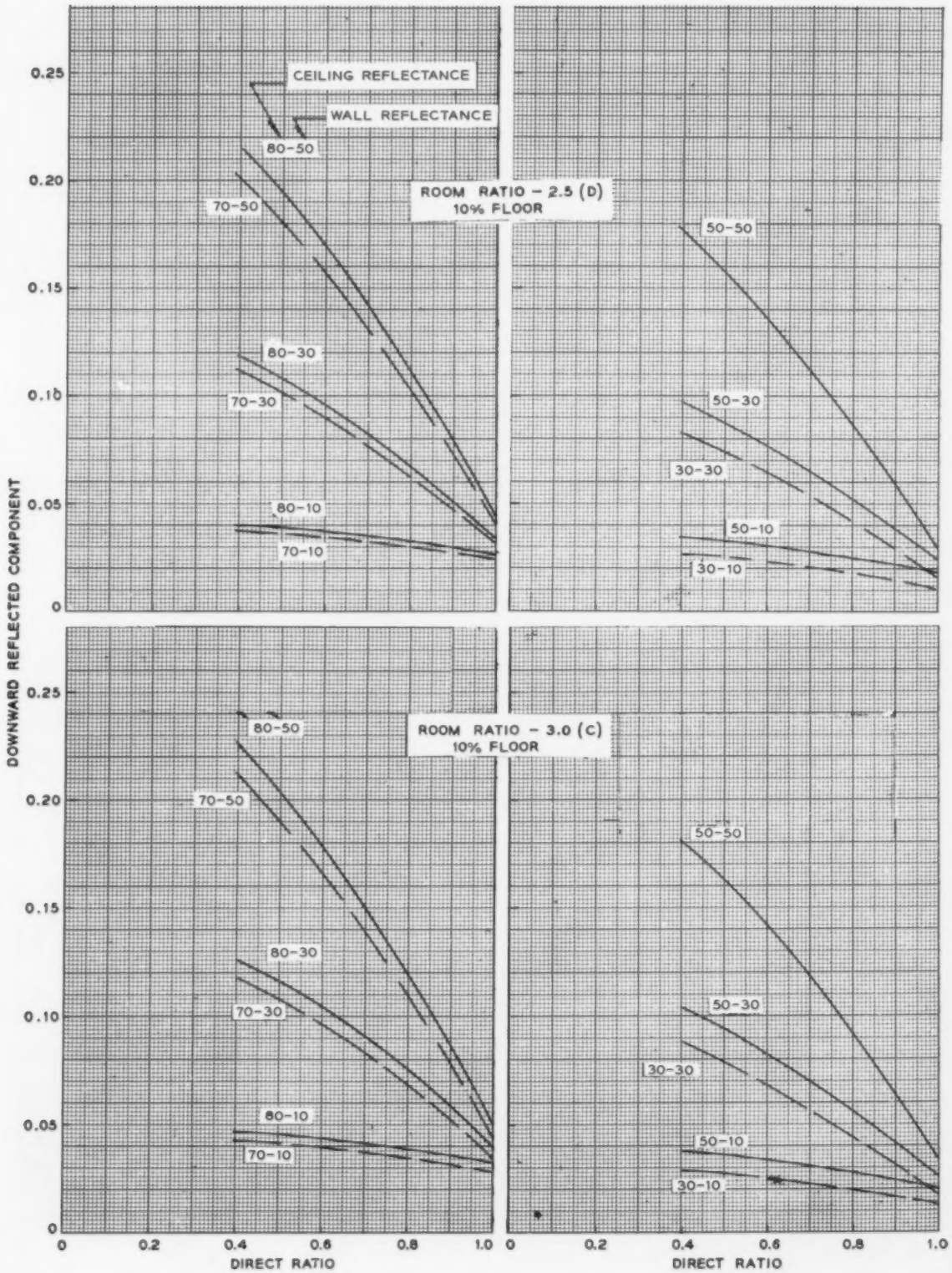


Figure 2a. Downward Reflected Component, Suspended Luminaires.

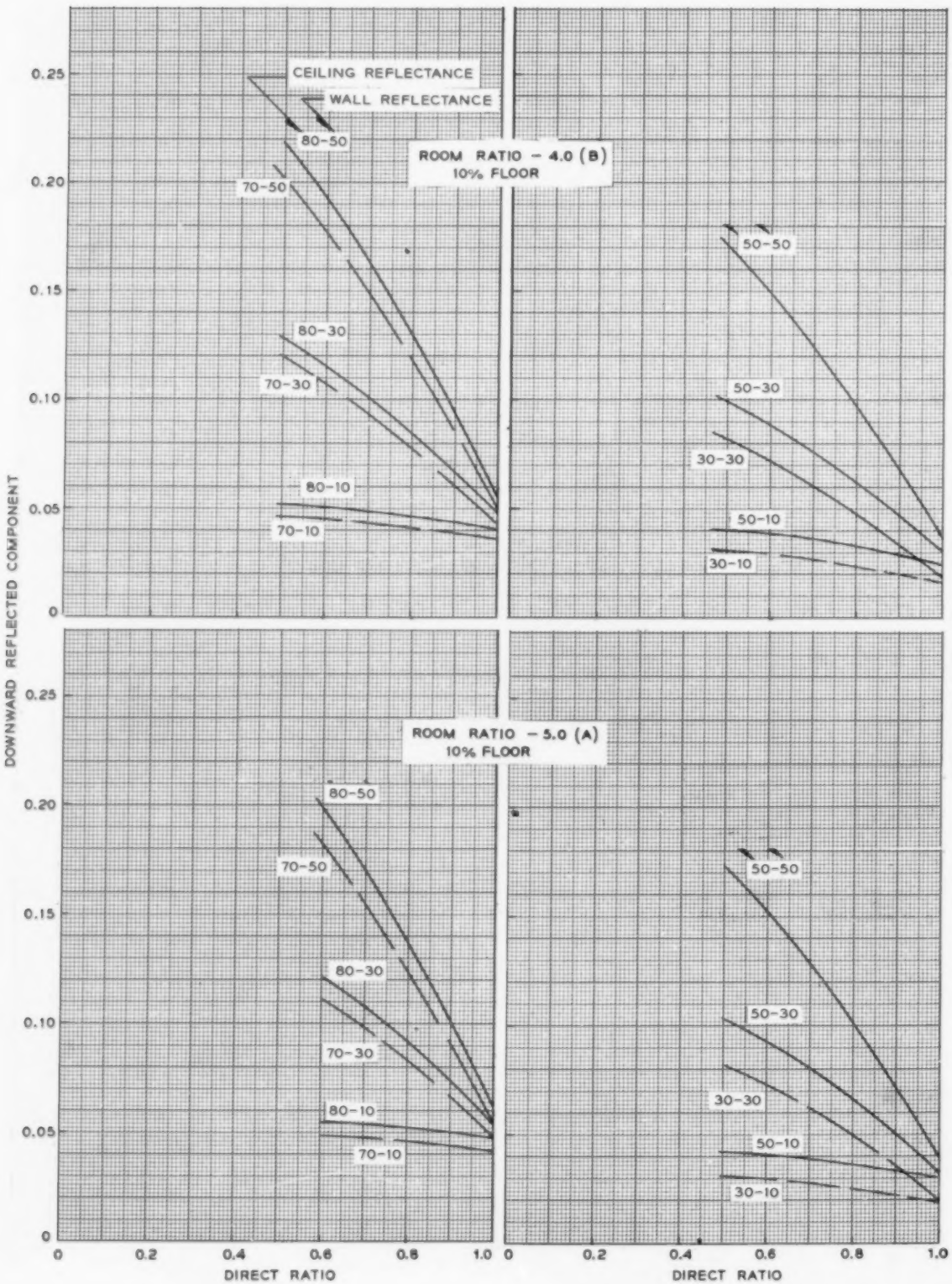


Figure 2b. Downward Reflected Component, Suspended Luminaires.

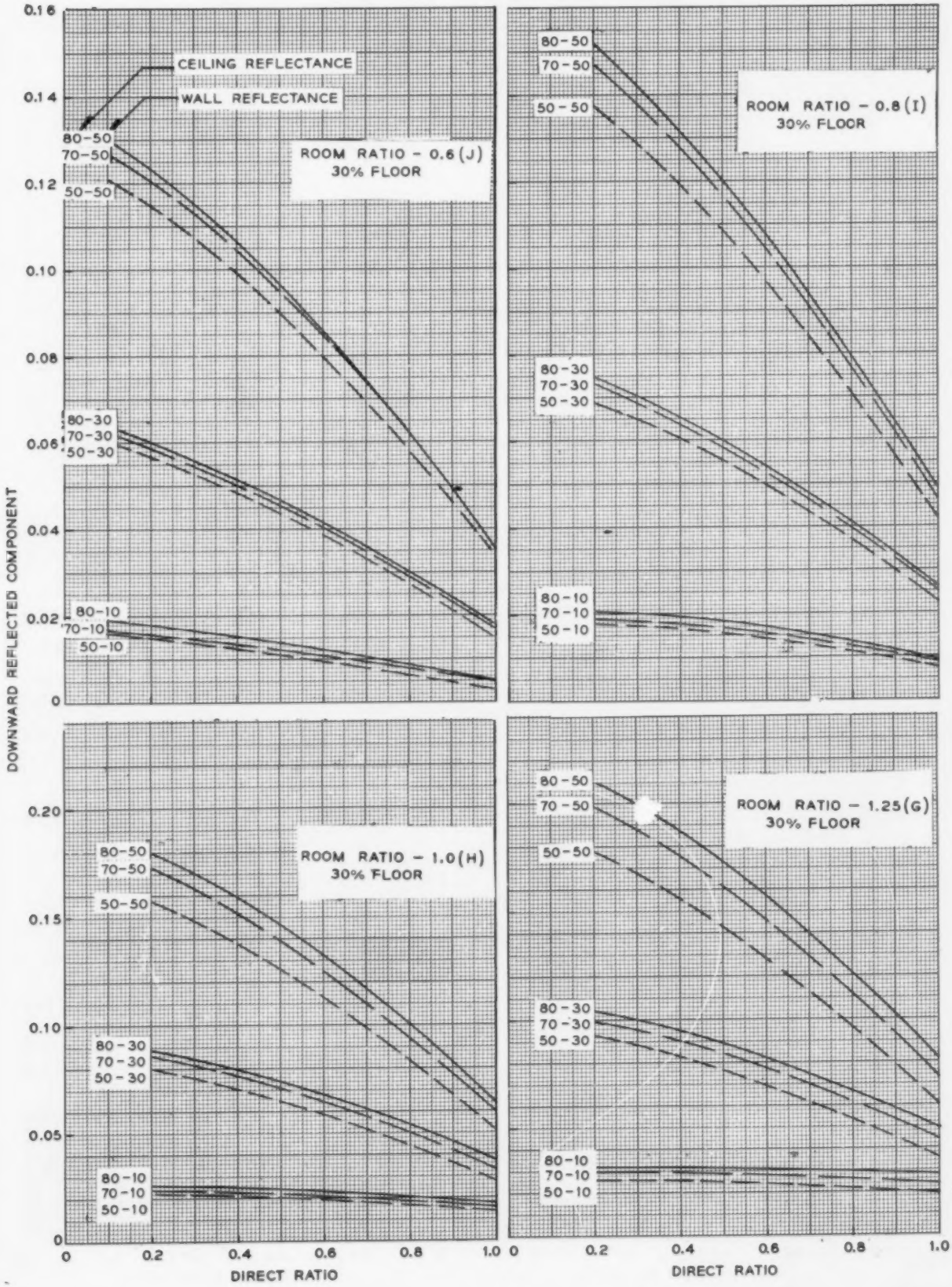


Figure 2b. Downward Reflected Component, Suspended Luminaires.

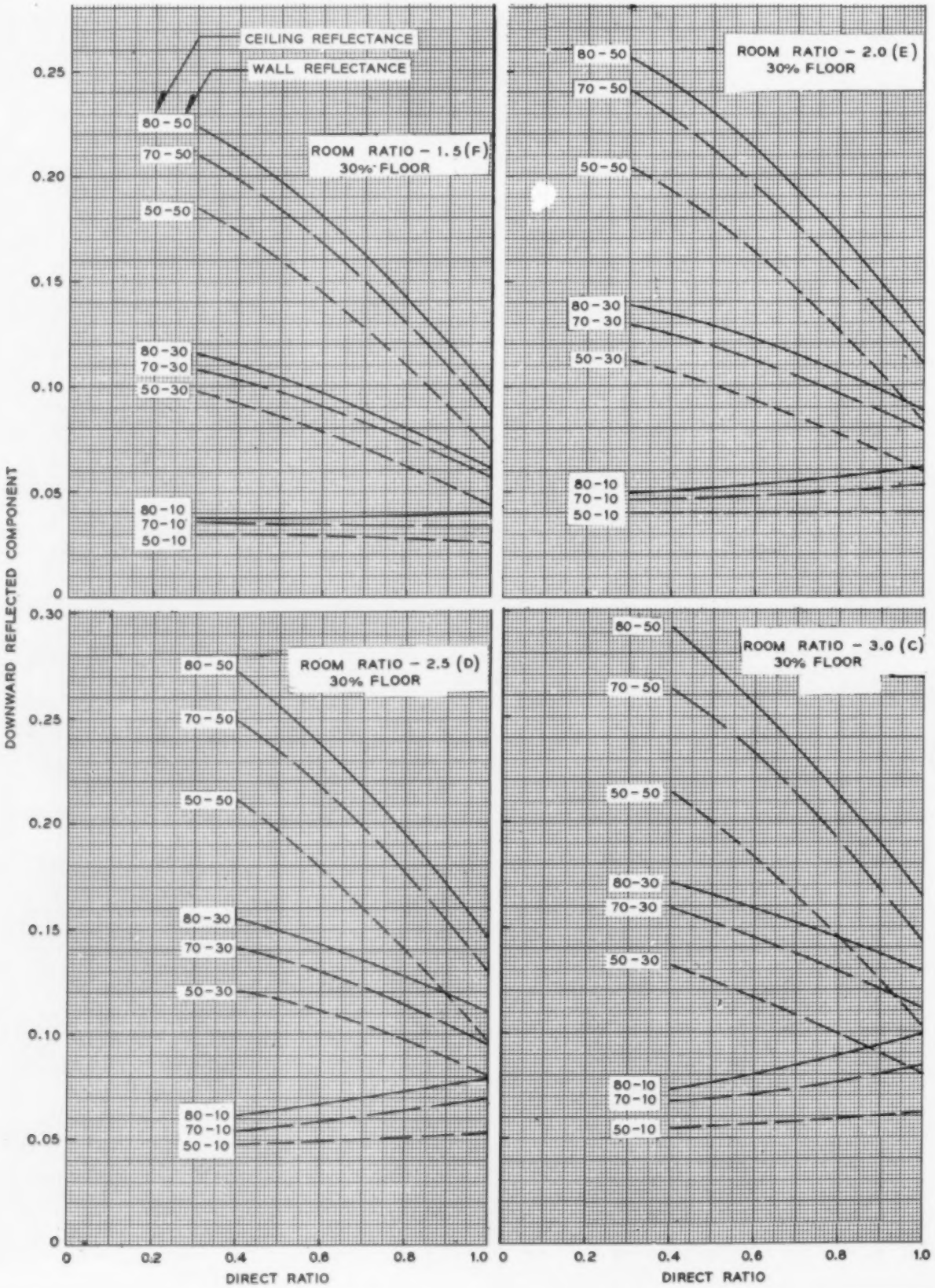


Figure 2b. Downward Reflected Component, Suspended Luminaires.

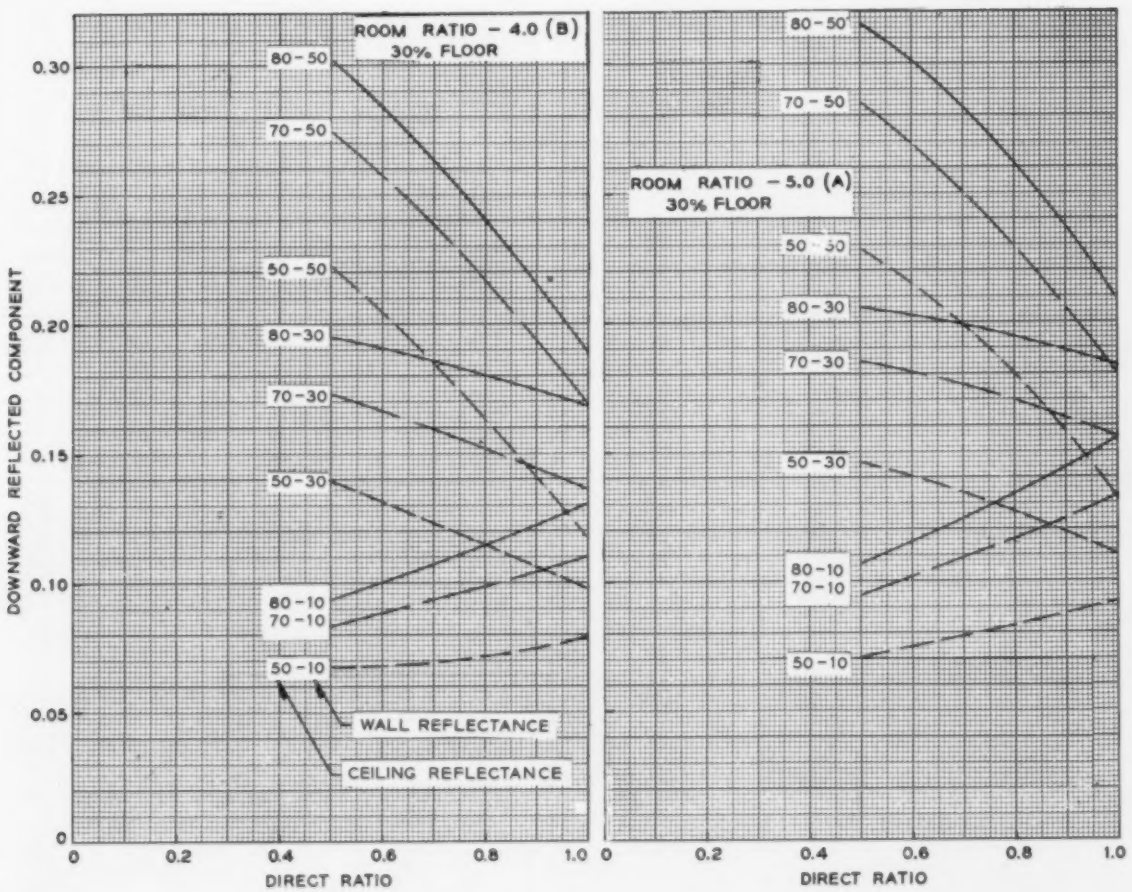


Figure 3a. Upward Utilization Factor, Suspended Luminaires.

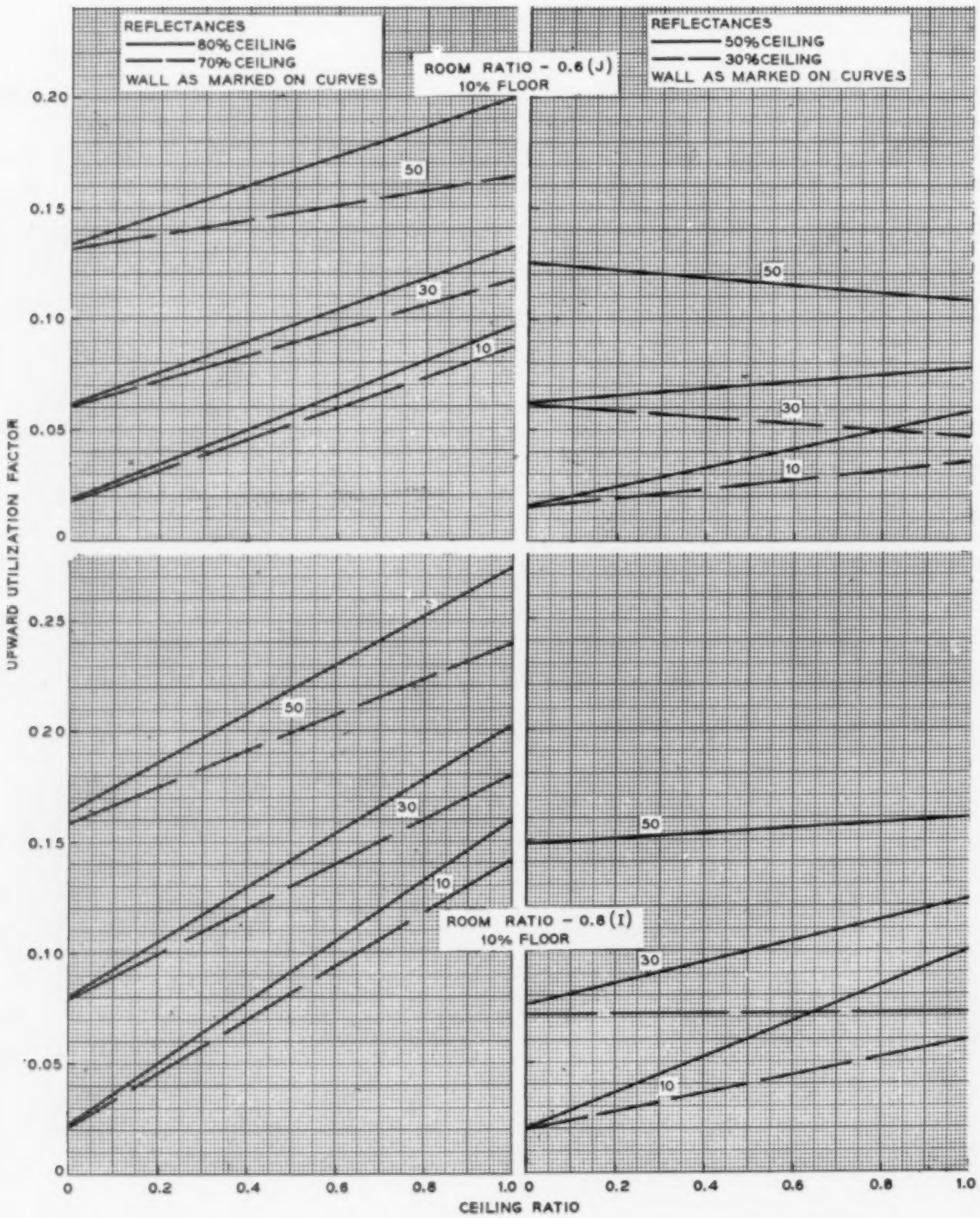


Figure 3a. Upward Utilization Factor, Suspended Luminaires.

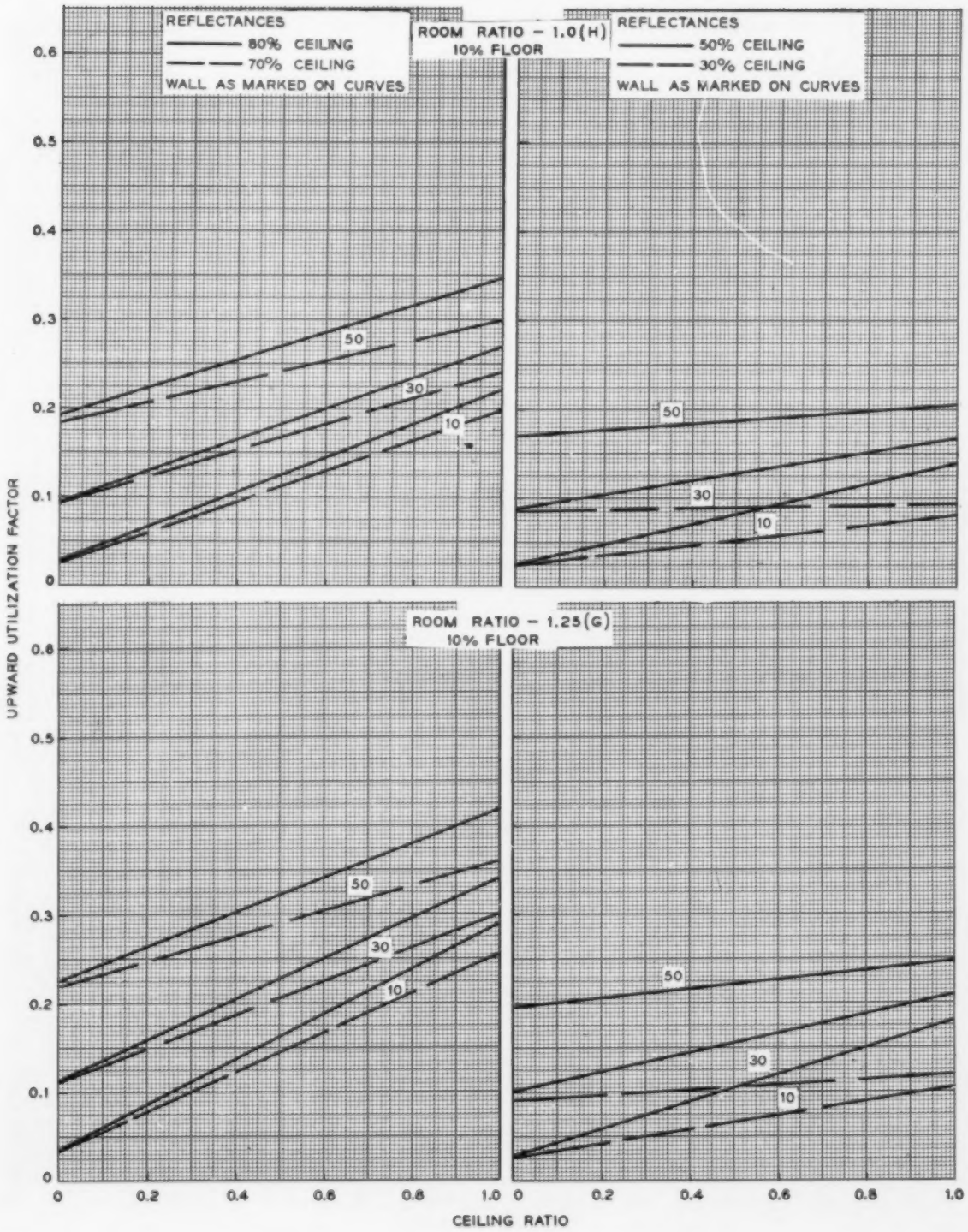


Figure 3a. Upward Utilization Factor, Suspended Luminaires.

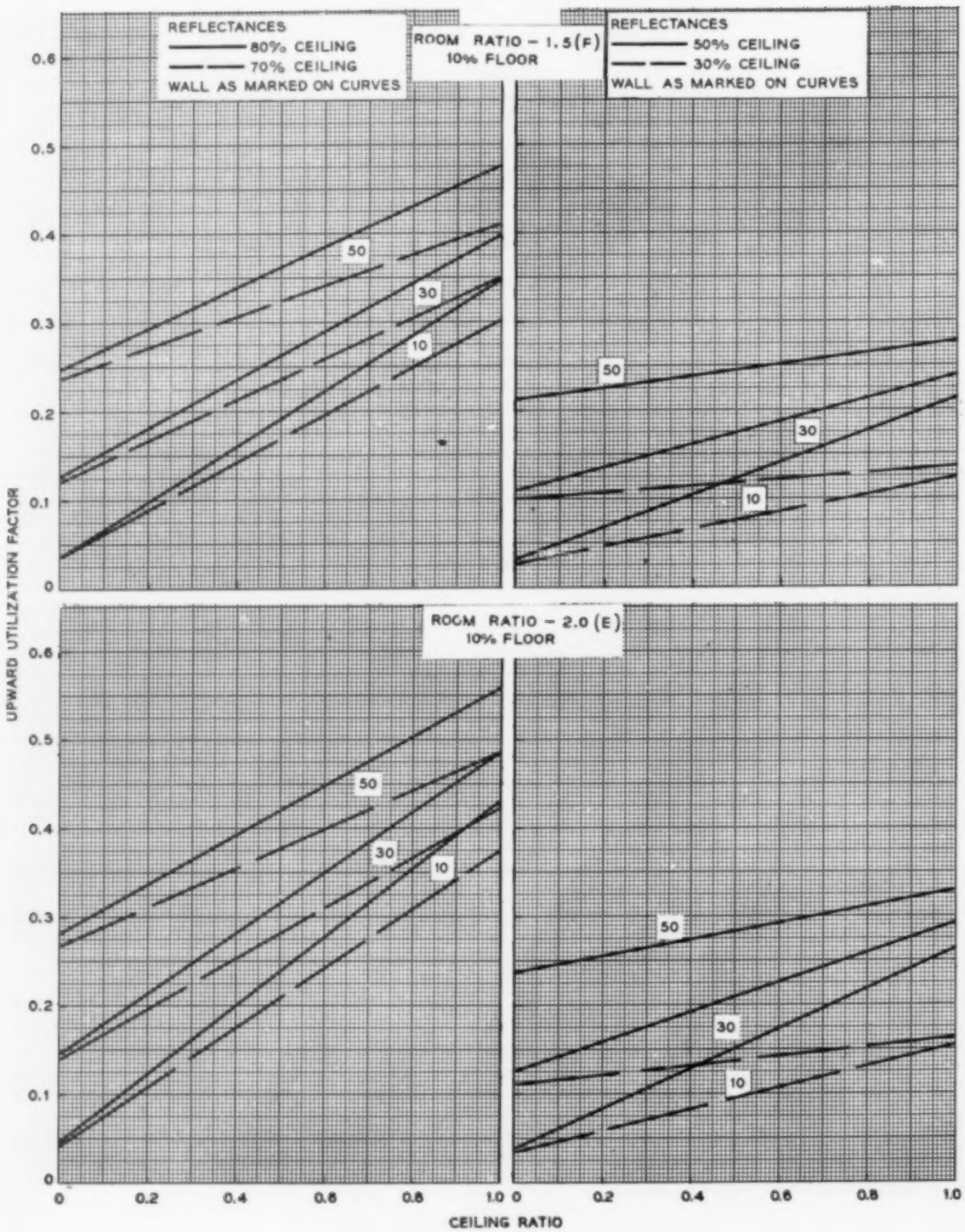


Figure 3a. Upward Utilization Factor, Suspended Luminaires.

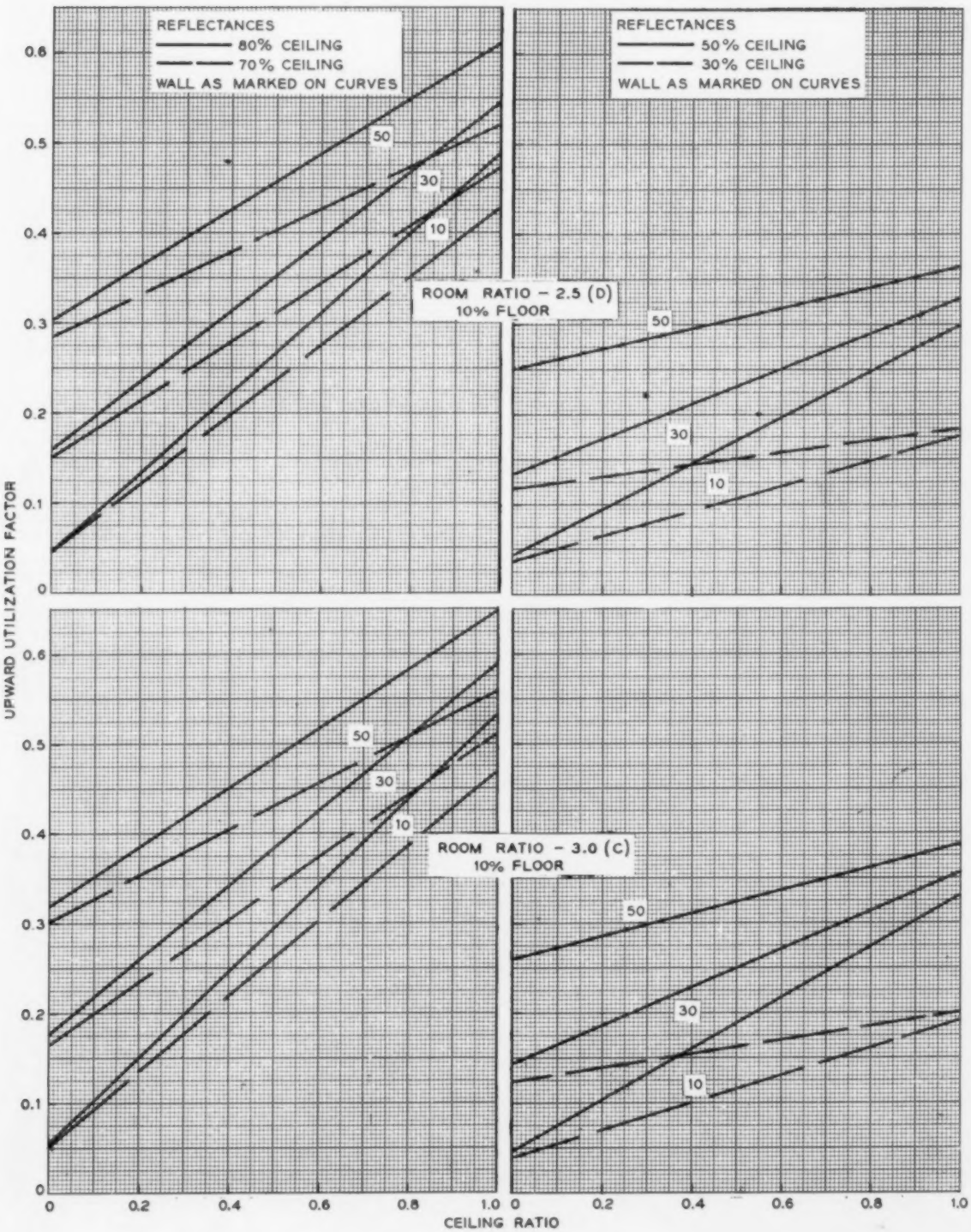


Figure 3a. Upward Utilization Factor, Suspended Luminaires.

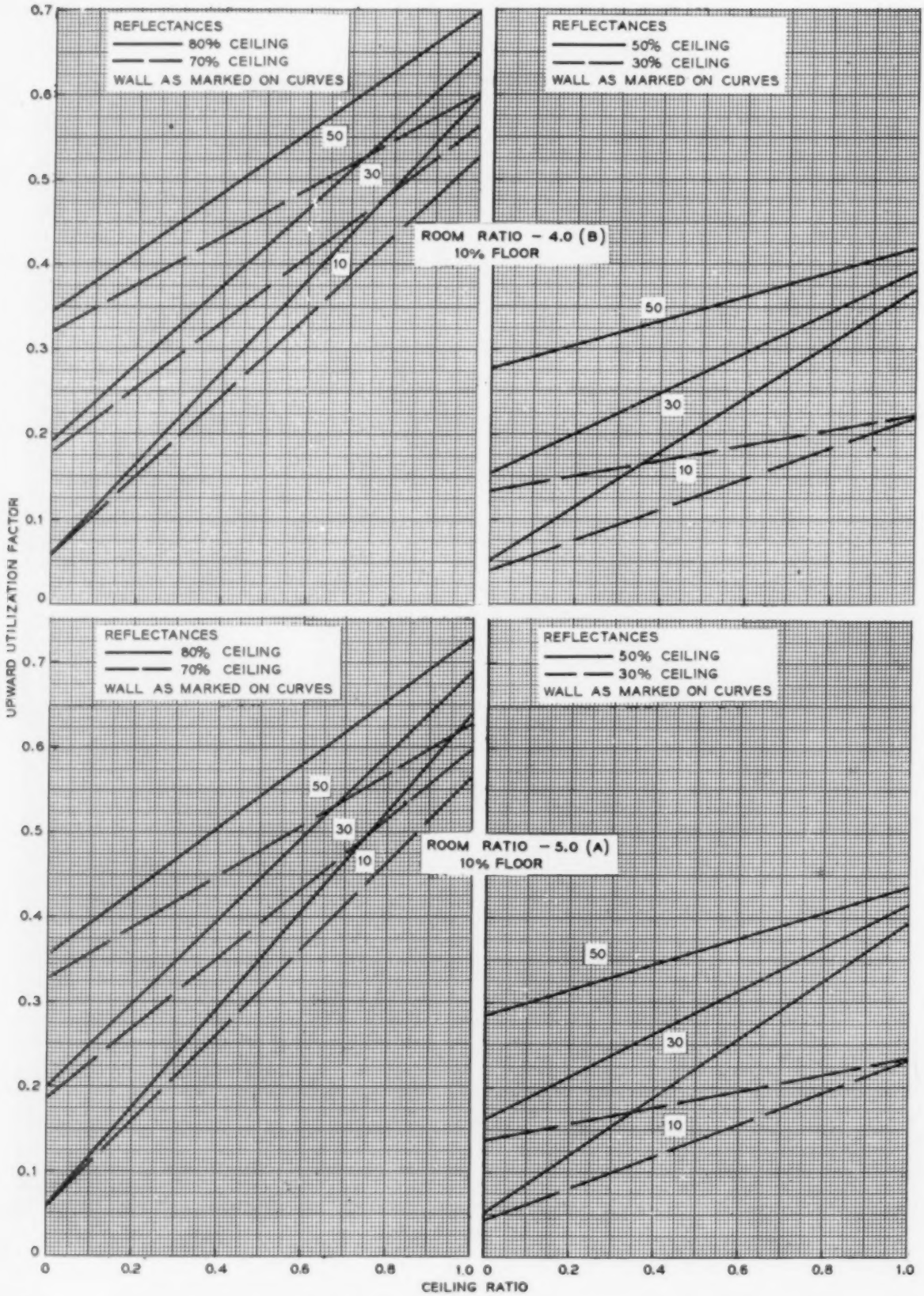


Figure 3b. Upward Utilization Factor, Suspended Luminaires.

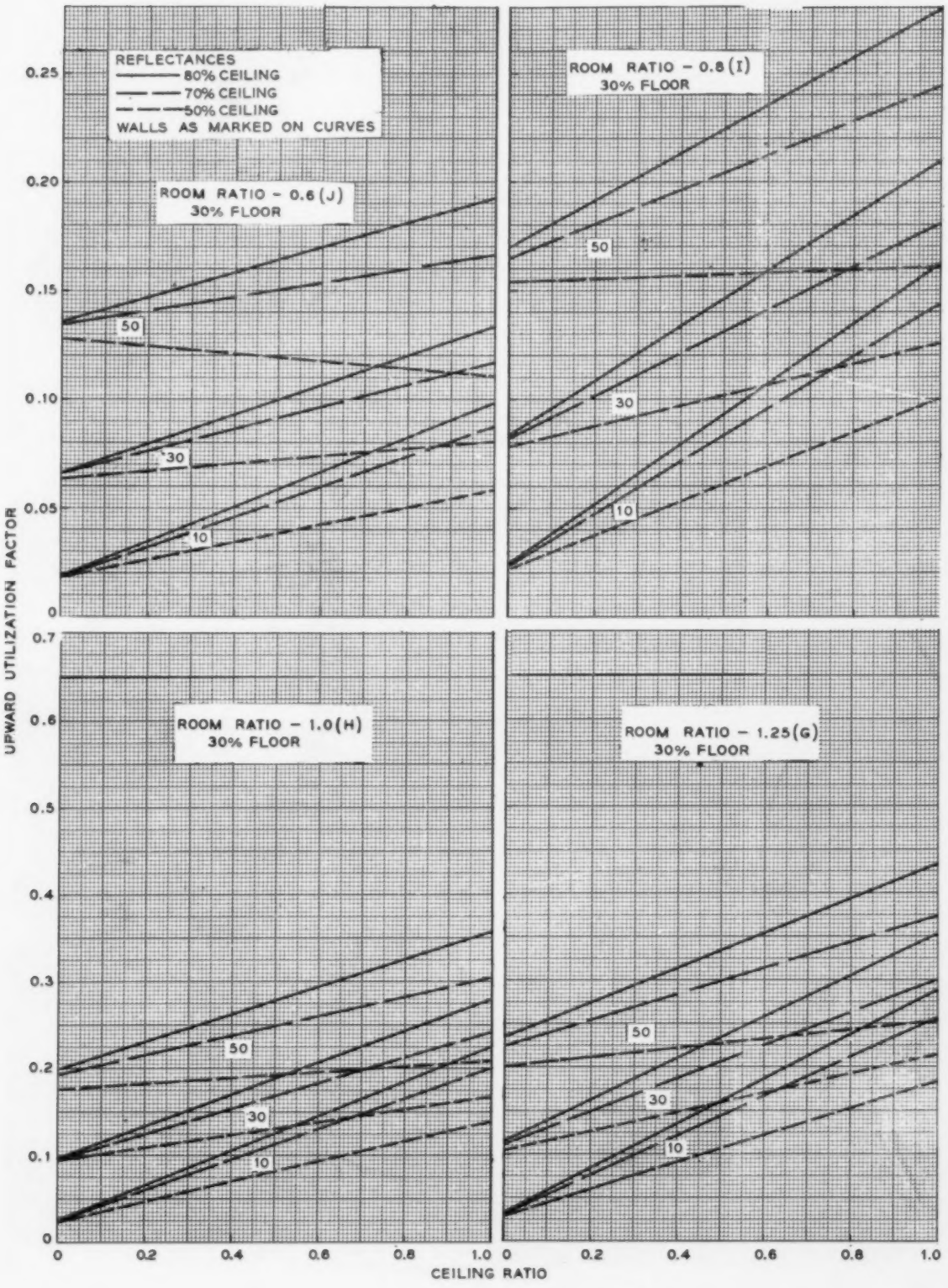


Figure 3b. Upward Utilization Factor, Suspended Luminaires.

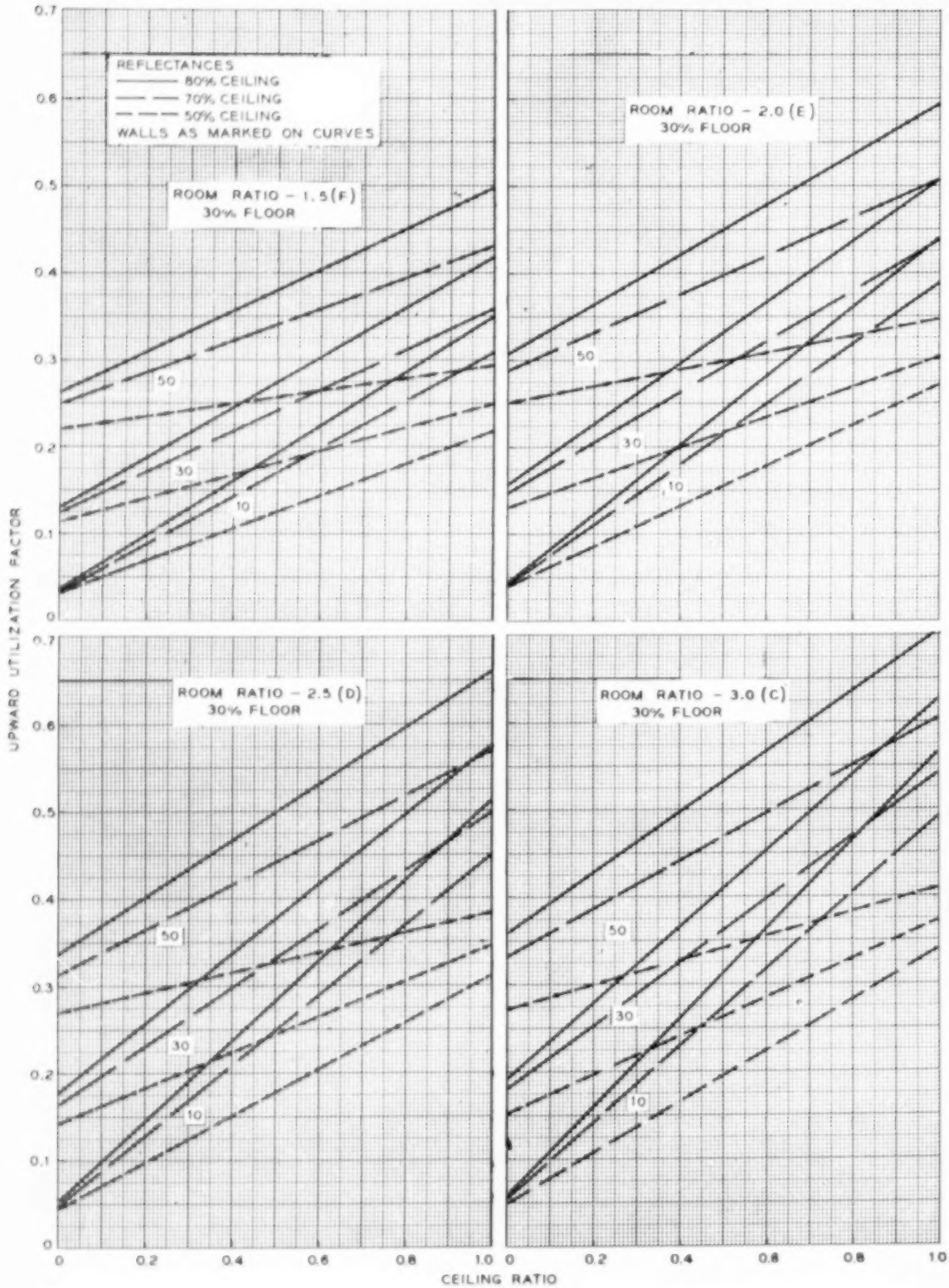
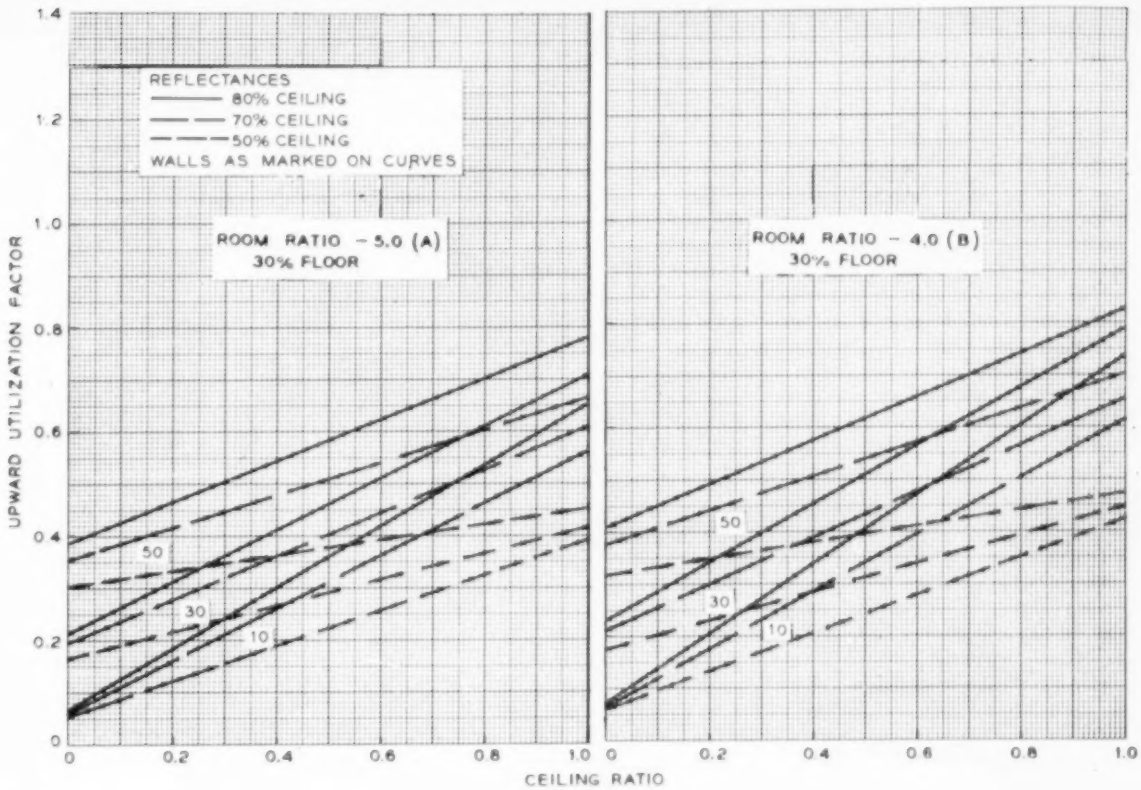


Figure 3b. Upward Utilization Factor, Suspended Luminaires




## Correction

**Current Lighting Practices for Color Television Production (Published December 1955 IE)**

The illustration at right showing a sequential camera should replace Fig. 4 printed with the report, which showed a tri-tube camera erroneously labeled sequential.

## Here and There With I.E.S. Members

LIGHTING COURSE offered by the Cleveland Section, I.E.S., consisted of six Tuesday evening classes starting February 7 (see page 23A, March ILJ). Registration for the course was 81. Standing at the back in photo are, left to right: C. H. Kyle; R. W. Morris; J. G. Mitchell; G. K. Warner, Section Chairman; R. C. Putnam, and W. S. Kolb. Mr. Morris, Mr. Kolb and Theodore Ake were in charge of the sessions, which were held at the auditorium of the new Electrical Building at Case Institute of Technology.

DINNER meeting of the Connecticut Section, I.E.S. on March 15 at Old Lyme, Conn., preceded an inspection of the Connecticut State Highway Department's highway lighting test strip. At the meeting were: left to right, Robert Chase, Program Chairman; J. D. C. Guy, Street and Highway Lighting Chairman; George A. Nagel, Associate Engineer, State Highway Department; Merritt Horner, Vice-Chairman of the Section; Robert Babcock, Section Secretary.

SPRING Conference of the Iowa Section, I.E.S., was held in Iowa City, March 16. In photo at left are, l. to r., back row: Midwestern Regional V-P J. R. Chambers, R. C. Holcombe, Charles Young, Charles Stone, Jim Hall, Lee Esthus and C. O. Christensen; front row: Section Chairman Lee Widigen and W. D. Barnhizer. In photo at

right are the winners of the Section's contest for My Most Interesting Lighting Job, left to right: John Severance, second place tie; R. C. Holcombe, contest chairman; Mrs. Mary Stafford, first prize; and Walter Greve, second place tie. (See winners of some other Sections' contests for MMILJ on page 10A.)

# TELECAST

## LIGHTING NEWS OF CURRENT INTEREST

## Council Travels South for April Meeting— Summary of Action Taken

In recent years Council of I.E.S. has scheduled one of its meetings away from headquarters. This year, at the invitation of the Alabama Section and the Southern Regional Conference, they met April 4 at the Thomas Jefferson Hotel in Birmingham, Ala. First-hand experience in Society administration was afforded to local members, some 18 of whom sat in at the Council meeting. R. F. Hartenstein, President, presided.

Approval of the February and March Minutes made it official that proposed amendments to the Constitution would be placed before the membership for ballot approval. These were: change in dues and establishment of a new membership grade for retired Associates, Members and Fellows.

Additional appointments were made for committee personnel. On action taken regarding a later report by the Procedures and Policy Committee, G. W. Beals, Chairman, Council approved a statement of policy whereby committee appointments will be limited to those actually needed and active in the current year, and that the names of members of the major committees and subcommittees will continue to be published in I.E.

Financial matters were, of course, reported and studied, including a statement of receipts, expenditures and liquid assets of the Society at the end of the six month period in the fiscal year.

Membership statistics were reported by the General Board of Examiners, Svend Bruun, Chairman. They reported their election of 145 Associate Members, 3 Student Members, and recommendation for Council approval of the election of 18 Members.

The death of Dr. E. C. Crittenden, President of the Society in 1924-25, Fellow and Gold Medallist, was reported. Following a moment of silent tribute, action was taken to enter in the Minutes a commemorative resolution covering the appreciation of I.E.S. for the many contributions of Dr. Crittenden during his lifetime to the basic science of illuminating engineering.

Current membership totals reported by the Executive Secretary were shown to be as follows:

| September 30, 1955 | | April 4, 1956 |
|---|---|---|
| 8178 | Total Membership | 8634 |
| 35 | Members Emeritus | 36* |
| 89 | Fellows | 89 |
| 1979 | Members | 2068 |
| 5887 | Associate Members | 6234 |
| 188 | Student Members | 209 |

*Includes 11 Fellows.

Sustaining Membership activities are still going forward with marked success, apparently. In the absence of Fred Guth, Chairman of this program, Brooks Chassaing requested the approval of eight new members, the reinstatement of one former member, and the increase of dues for five members. New members elected were:

Carroll Sales Co.
19354 James Couzens Highway
Detroit 35, Mich.
Official Representative: T. G. Carroll

Florida Power Corp.
101 Fifth St., South
St. Petersburg, Fla.
Official Representative: William B. Shank

Georgia Power & Light Co.
Valdosta, Ga.
Official Representative: To be named

Monongahela Power Co.
1310 Fairmont Ave.
Fairmont, W. Va.
Official Representative: H. A. Stroud

Pfaff & Kendall
84 Foundry St.
Newark, N. J.
Official Representative: M. J. Hamilton

Stickler Electric Supply Co.
346 Ann St.
Hartford 3, Conn.
Official Representative: Marshall Stickler

R. M. Tower Co., Inc.
Dewey St.
Bridgeport, Conn.
Official Representative: Harvey N. Tower

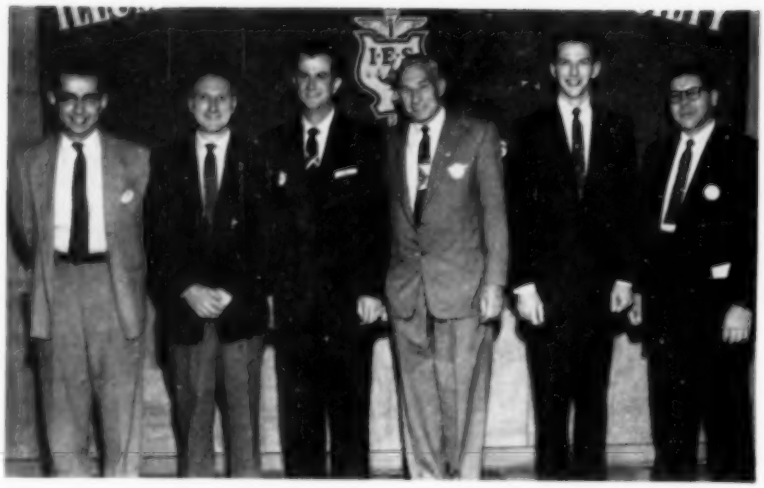
Voltare Tubes, Inc.
44 Cross St.
Norwalk, Conn.
Official Representative: Wallace G. Hill

The Publications Committee, J. S. Schuchert, Chairman, reported on the progress of this program. Committee organization on this activity now includes representatives from each Section and Chapter and also one from each Region, he said, with local participation showing great promise for a successful program. A new publication, I.E.S. Dividends, just completed by the Publications Committee was displayed to Council; this booklet to be available for distribution at all Regional Conferences.

The Society's technical program was shown to be busy, from the report on this activity by C. L. Crouch and M. N.

**COUNCIL, meeting at Birmingham, takes a recess on the patio.**

## Some Section Winners MMILJ Contest



**SOUTHERN CALIFORNIA SECTION.** My Most Interesting Lighting Job Contest was held March 7. Winners, from left to right in the order in which they placed: First, Bill Jones; second, Ben Yeomans; runners-up, Phil Martin, C. B. Gabel, J. H. Shirley and Sy Hughes.

**ST. LOUIS SECTION.** Five finalists in MMILJ contest are, l. to r.: Carl Wettig, first prize; Hank Poehling; Sam Reizman, second prize; Roger Renkel; Nelson Bleish and Norman Rath, paired as entry winning third prize. The March 15 meeting was attended by 97 members and guests.

**GEORGIA SECTION.** Contest winners were determined at the March 19 meeting of the Section. Left to right are: Hugh Saussey, second prize for his bank lighting job; Miss Nina Faye Bonner, third prize for residence lighting; Mrs. Mary Bush, first place for a lighted garden entry; and, at right, Contest Chairman Bert L. Trapani.

**ARIZONA SECTION.** First prize winner James R. Williams receives congratulations from judges for his entry on the office and display area at Rudolph's Chevrolet. L. to r.: Mr. Williams; W. P. Reilly; I.E.S. Past President Prof. Everett M. Strong; and Paul Young. Contest was held at the Section's March meeting.

Waterman. An especially active issue is apparently the current deliberation between I.E.S., A.I.A. and National Council of Schoolroom construction, leading to a revision of the American Standard Practice of School Lighting. Mr. Crouch indicated that the Technical Committee on Light Control and Equipment Design is also planning a new and active program. Another area of current study was research being undertaken on visibility under street and highway lighting conditions including fog research programs, it was reported.

A new report was approved for publication. This was "Demand for Professionally Trained Illuminating Engineers," submitted by H. H. Magdsick, Chairman of the Lighting Education Committee.

The Membership Committee, W. A. Stannard, Chairman, also reported, showing an analysis of the gains and losses to date. A special drive for the enrollmen of consulting engineers is part of their current plans, he said, as well as nation-wide activity in general membership.

Residence Lighting Forums are another activity showing considerable progress, according to the report of this Committee made by Ruth Morris, Chairman. She noted that there are now eight Forums active in connection with Sections and Chapters, with prospects for several more in the near future. She reported that the committee has circulated typical good programs and outlines of special projects, to assist with the programs of the Forums, and that the committee is also preparing an excellent session to be presented at the Boston Conference.

Regional Activities were reported by Kirk Reid, Chairman of this Committee. One of the committee's recommendations (subsequently approved by Council) involved a division of the Southern Region into two separate Regions. Effective October 1, 1956, southern Sections and Chapters will be organized under two Regions, details of which are covered in a separate news item in this issue.

Firm dates and hotel locations for the 1957 Regional Conferences were reported by Mr. Reid, together with several for 1958. He also reported that six study projects were initiated by this committee so far this year, two of which are now complete (analysis of needs for Regional Vice President travel funds, and a standard proposed agenda for Local Activities meetings at Regional Conferences).

Study Clubs and their financial requirements had also been studied by this committee, and Mr. Reid reported their recommendation that increased help be given to Sections and Chapters for such extension activities. This is now under study by the President's Advisory Board.

Final business before adjournment was the appointment of Kirk M. Reid, Vice President, to serve as the Society's representative at the 50th Anniversary Celebration of Cooperative Education being observed at the University of Cincinnati on April 19th.

## Southern Regional Conference in Birmingham Host to Three I.E.S. Meetings

Some day, prediction-makers say, top I.E.S. meetings will be the Regionals, with maybe no national conference at all. A glimpse around the Thomas Jefferson Hotel in Birmingham, Alabama any day between April 3 and April 7, inclusive, lent weight to such a rumor. For one thing, the place was alive with national I.E.S. officers, national committee chairmen, and of course, some 190 members from all twelve Sections and Chapters of the Southern Region. Midwest, New England and Eastern accents mingled companionably with soft Southern drawls in discussion of mutual I.E.S. interests. The Alabama Section, host to the Regional Conference April 5 and 6, had also invited Council to hold its April meeting in Birmingham April 4. (For account of action taken by Council, see summary elsewhere in this Section.) April 3 was busy too, with full-scale meetings of the national committee on Publications (J. S. Schuchert, Chairman) and the Regional Activities Committee under the direction of Kirk M. Reid.

Presence of national brass, however, was by no means the chief "top-meeting" factor. The program itself was excellent. Eleven papers and addresses were featured, all extremely valuable, and all delivered to literally s.r.o. sessions. As will be noted from program details, below, these included famous lecturers from all parts of the country—R. F. Hartenstein, President; C. L. Crouch, Technical Director; George J. Taylor, I.E.S. General Secretary; Kirk M. Reid and Marshall Waterman, both national Vice Presidents; J. D. Mitchell, Southern Regional V.P.; W. P. Lowell, Jr., from Salem, Mass., well-known for his educational lectures; E. B. Karns from Cleveland and Ray Kruse from Philadelphia, ditto. Local talent was also featured in Miss Emily Alexander from Atlanta, a top practitioner in the residential and garden lighting fields. Keynote address, following the Invocation by Bishop George M. Murray of Alabama, was by E. C. Easter, Vice President of the Alabama Power Company. Mr. Easter's address was an inspiring start to a most worthwhile meeting, as was the excellent Invocation.

**KEYNOTE address at opening session was given by E. C. Easter, Vice-President, Alabama Power Co. Seated, from left to right, are: Regional V-P J. D. Mitchell, President R. F. Hartenstein, and General Conference Chairman Joe Prettyjohn.**

**COCKTAIL PARTY was given by the Conference host, Alabama Section. Left to right are: F. H. Britton, Chairman of the Papers and Program Committee, Mrs. R. F. Hartenstein and I.E.S. President Hartenstein.**

**SOME 40 visiting ladies attended luncheon and a fashion show at the Birmingham Country Club. They later toured the city. Ladies entertainment program was under the direction of Edith Hitchcock, Alabama Power Co.**

The Social functions too were worthy of national rating. Some 40 visiting ladies enjoyed a full program planned for them, and conducted under the direction of Miss Edith Hitchcock of Alabama Power Company. All present attended a cocktail party given by the Alabama Section (one feature of which was Southern beauties passing the peanuts). On Friday evening, President and Mrs. Hartenstein were honored at a Smorgasbord dinner and dance. One of the highlights, aside from the superb Southern food, was presentation of a gift from the Southern Region to the Hartensteins — a beautiful silver platter. Abetting all this, especially for the Yankees, was a foretaste of Spring. Early April in Alabama has much to be said for it.

Another social function of great charm was a dinner given by Mr. and Mrs. E. C. Easter for Council officers and their wives, Wednesday evening April 4. Dinner, followed by dancing, was at "The Club," a very beautiful private club at the peak of Shade Mountain, surrounded by gardens (in full bloom of Spring) and with an unsurpassed view of the city. Mr. and Mrs. Easter were hosts to some thirty guests at this affair.

Not all of the fun occurred at the

(Continued on page 15A)

**PEANUTS were passed by two Southern belles, at the cocktail party. One lovely model is shown here with Cecil Cannon and Joe Prettyjohn.**

**ERSTWHILE Yankees (ugh) were formally reconstructed as Southerners during a ceremony at Friday luncheon. Reconstructed rebels were given certificates and Confederate flags to prove it. Left to right they are: Wes McCormick, Ruby Redford, C. L. Crouch, George J. Taylor, Kirk Reid, Marshall Waterman, R. F. Hartenstein and C. E. Ellis.**

**Memo to Members of the Southern Region**

Y'all come see us in Boston, henh?

(Signed)
RECONSTRUCTED REBELS

# Silent Partner

The "Rancho Park" branch of the California Federal Savings and Loan Association installation of the Sunbeam 4' x 4' recessed luminous squares by Sunbeam Lighting Company, Los Angeles, California.

**EFFICIENCY • ENDURANCE • ECONOMY**

To receive peak performance from fluorescent lighting it is most essential that the ballast . . . the heart of a fluorescent fixture . . . match precisely the electrical requirements of the lamp it has been designed to operate. The fluorescent lamp ballast should have endurance to supply years of quiet, trouble-free service and it must provide economy of operation.

ADVANCE fluorescent lamp ballasts are synonymous with *Efficiency, Endurance, Economy*. ADVANCE ballasts are the result of extensive engineering, research and precision manufacturing methods, enabling us to produce in volume the most complete line of fluorescent lamp ballasts in the world . . . and back each ballast with a two-year guarantee. Whether you manufacture, specify, install or maintain fluorescent lighting make ADVANCE your Silent Partner and be assured of the most efficient, longest lasting, economical fluorescent lamp ballasts you can use.

*The Heart of the Lighting Industry*

**ADVANCE TRANSFORMER CO.**

World's Largest Exclusive Manufacturer of Fluorescent Lamp Ballasts

2950 No. Western Ave. Chicago 18, Illinois

*Recommended for* LOW MOUNTING HEIGHTS

# HOLOPHANE REFLECTORS

*with* MERCURY LAMPS

- ***Deep-Shielded Glareless Illumination***
- ***High Output from Long Life Sources***
- ***Low Operating and Maintenance Costs***

*Photos Shown (Above) Wolverine Tube Division of Calumet & Hecla, Inc.; (Below) Kaiser Aluminum and Chemical Co.*

*For Better Lighting* Holophane *Be Specific*

Holophane research has perfected an entirely new and practical approach for illuminating industrial interiors with low mounting heights. The new unit, 635-AL, designed for mercury vapor lamps has proved highly efficient in a wide range of low bay applications. In some of these, the ceiling is as low as 12 feet above the floor, 9 feet above the work plane . . . The unit consists of a metal-covered prismatic glass reflector assembly and ventilated socket housing. Its outstanding features are deep shielding and high outputs in useful lumen zones. The open bottom assures easy maintenance and simple lamp replacement . . . Write for complete engineering data; no obligation.

**HOLOPHANE**

**HOLOPHANE COMPANY, INC.**
*Lighting Authorities Since 1898*
342 Madison Ave., New York 17, N.Y.
THE HOLOPHANE CO., LTD., THE QUEENSWAY, TORONTO 14, ONTARIO

**HARD AT IT** at 7:30 a.m., Southern Region's Local Activities Committee met with Regional V-P J. D. Mitchell, President R. F. Hartenstein, and Regional Activities Committee Chairman Kirk Reid.

**TECHNICAL** Director C. L. Crouch was speaker at the Friday luncheon, discussing the technical and research activities of I.E.S. Mr. Crouch will be a speaker at all the Regional Conferences this year.

(Continued from page 12A)

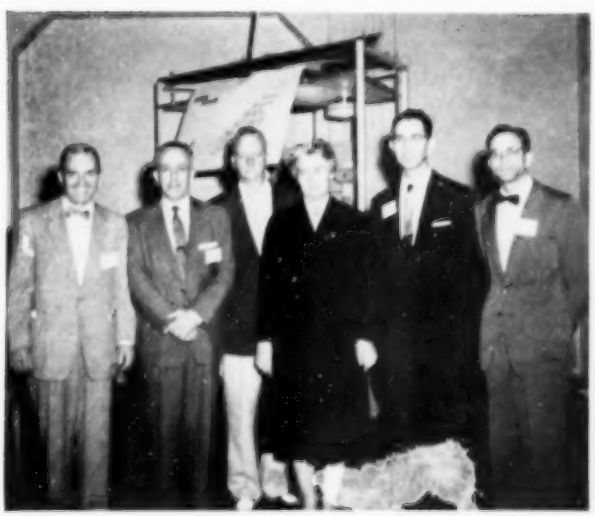
parties. During the luncheon session April 6, eight Yankees (ugh!) present, were "reconstructed." Publicly taking an oath to uphold the principles of Theodore (The Man) Bilbo, Eugene Talmadge and others, these erstwhile Yankees (ugh!) were formally inaugurated as Southerners, given a certificate to prove it, and decorated with Confederate flags. These they wore throughout the rest of the Conference, including the dance.

Chairman of all this, including the reconstruction ceremony, was Joe Pettyjohn, General Conference Chairman. Each of the separate sessions was moderated by the various chairmen of the Southern Region local groups. Helping these officers was an able group of committee chairmen, each handling separate phases of the Conference operation (see Credits below).

### M.M.I.L.J. Contest

Few I.E.S. Regions take the My Most Interesting Lighting Job contest more seriously than the Southern Region. Nor put on a better one. Six Sections contested for the prize, at a session devoted entirely to this activity Friday afternoon. Winner was New Orleans Section, represented by Louis N. Goodman, and his installation showing lighting variety in a modern building. Second prize was won by Tar-Heel Section, James J. Cardo (Lighting Showroom). Third prize went to Mrs. Mary Bush, Georgia Section, for her garden lighting job. Also competing in this contest were the Mid-South Chapter (James F. Fletcher), Alabama Section (Donald G. Hallmark) and Tennessee Valley Section (James N. Stansell). Mr. Goodman, already a three-time national winner, will represent the Southern

(Continued on page 16A)



**CONTESTANTS** in MMILJ Contest, left to right: James N. Stansell, Tennessee Valley Section; Louis N. Goodman, New Orleans Section, First Prize winner; D. G. Hallmark, Alabama Section; Mrs. Mary Bush, Georgia Section, Third Prize; James J. Cardo, Tar-Heel Section, Second Prize and James F. Fletcher, Mid-South Chapter.

**JUDGES** in MMILJ Contest studying entries, left to right: C. L. Crouch, Technical Director; Marshall N. Waterman, I.E.S. Vice-President; Paul F. Gratin, Chairman of the session; R. F. Hartenstein, President; Ruby Redford, Editor of IE; and C. W. McCormick, Northwestern Regional Vice-President.

(Continued from page 15A)

Region in Boston next September. Judges for this contest were C. L. Crouch, Technical Director, I.E.S., R. F. Hartenstein, President, M. N. Waterman, Vice-President, W. M. McCormick, Northeastern Regional V-P, and Ruby Redford, Editor of I.E.

Another award captured by the New Orleans Section at this Regional Conference was the plaque for attendance. This is annually awarded by the Region to the Section or Chapter having the greatest number in attendance, in per cent of Section membership, and in relation to miles traveled to the Conference. As at the National Conference just about every year, New Orleans had the mostest who came the farthest.

PROGRAM DETAILS

For the record, the following program was presented before the 1956 Southern Regional Conference:

### Thursday, April 5, 1956

MORNING SESSION — Presiding: E. B. Richey, Chairman, Alabama Section.

Invocation — Bishop George M. Murray, Suffragan Bishop, Episcopal Church—Alabama Diocese.

Opening Remarks — W. J. Prettyjohn, General Chairman, Southern Regional Conference.

Address of Welcome — E. C. Easter, Vice-President in Charge of Sales, Alabama Power Co.

Address — "50 Years of IES—Story on Future" (Introduction by J. D. Mitchell), R. F. Hartenstein, President, Illuminating Engineering Society.

Progress of Light Sources — W. P. Lowell, Jr., Sylvania Electric Products.

Residential & Garden Lighting — Miss Emily Alexander, Georgia Power Company.

LUNCHEON SESSION — Presiding: W. H. Sadler, Chairman, Suwannee River Chapter.

Fifty Years of Technical Activity — M. S. Waterman, Westinghouse Electric Corporation.

AFTERNOON SESSION — Presiding: Judd Lough, Chairman, Georgia Section.

Developments in Street Lighting — E. B. Karns, Westinghouse Electric Corp.

Outdoor Lighting Opportunities in Shopping Centers — Kirk M. Reid, General Electric Company.

### Friday, April 6, 1956

MORNING SESSION — Presiding: C. H. Patterson, Chairman, Tennessee Valley Section.

Brightness Consideration in School and Office Lighting — George J. Taylor, Day-Brite Lighting, Inc.

Role of Plastics in Lighting — Ray Kruse, Rohm & Haas Company.

Southern Region's Part in IES — J. D. Mitchell, Regional Vice-President.

LUNCHEON SESSION — Presiding: J. M. Gensburger, Chairman, New Orleans Section.

Current Research & Technical Program of IES — C. L. Crouch, Technical Director of I.E.S.

AFTERNOON SESSION — Presiding: Paul F. Cratin, Chairman, Arkansas Chapter.

"My Most Interesting Lighting Job."

Closing Remarks — W. J. Prettyjohn.

CREDITS

Quite obviously a great many people, from every Section and Chapter in this Region had a hand in its success. Direct responsibility was charged to the following:

**General Conference Chairman**.....Joe Prettyjohn
**Regional Vice President**.....J. D. Mitchell
**Ass't Regional Vice President**.....G. L. Morris

*Conference Executive Committee*

Regional Vice President.....J. D. Mitchell
Chairman, Alabama Section.....E. B. Richey
Co-Chairman.....F. H. Britton, Jr.
Secretary-Treasurer.....Jack Keyser

*Committee Chairmen*

Finance.....Jack Keyser
Papers and Program.....F. H. Britton, Jr.
Attendance and Publicity.....S. A. Johnson
Hotel, Registration & Reception.....J. R. Fuller
Arrangements.....D. G. Hallmark
**Transportation**.....R. B. Brown
Entertainment.....Dudley Traylor
**Ladies Entertainment**.....Miss Edith Hitchcock

*Section and Chapter Chairmen*

Alabama Section.....E. B. Richey
**Arkansas Chapter**.....Paul F. Cratin
Florida Section.....J. A. Savarese
Georgia Section.....Judd Lough
**Mid-South Chapter**.....H. S. Chilton, Jr.
Mississippi Chapter.....L. H. Hickman
New Orleans Section.....J. M. Gensburger
**Palmetto Chapter**.....G. M. Rice
Southeast Florida Chapter.....J. A. Forester
Suwannee River Chapter.....W. H. Sadler
**Tar Heel Section**.....Coy C. Jordan
Tennessee Valley Section.....C. H. Patterson

**I.E.S. 50TH ANNIVERSARY meeting of the Tar Heel Section was held April 2, with President R. F. Hartenstein as special guest of honor. Left to right are: Mr. Hartenstein; Coy Jordan, Section Chairman; and Mrs. Hartenstein.**

## Iowa Section Celebrates I.E.S. 50th Anniversary

The mayor of Iowa City, Iowa, was on hand to cut the cake at the March 16 meeting of the Iowa Section, I.E.S., which celebrated the Society's Fiftieth Anniversary. Also honored were all Past Chairmen of the Section.

Program for the meeting was the contest for My Most Interesting Lighting Job, which was won by Mrs. Mary Stafford. Duplicate second place prizes were awarded to John D. Severance and Walter Greve.

## Modern School Lighting — Topic Of Arizona Section Course

The Arizona Section of I.E.S. sponsored a three-session course on Modern School Lighting, April 20 and 21. The classes were held at the North Phoenix High School Auditorium. Topics and speakers were:

### April 20 — Afternoon

Light and Sight — J. D. Whitnell, Arizona Public Service Co., Phoenix.

Lighting Terminology — S. L. Burnham, General Electric Co., Lamp Division, Phoenix.

School Lighting Tasks — R. Godemann, Arizona Public Service Co., Phoenix.

Light Sources — S. L. Burnham.

Principles and Systems of Light Control — Roy Bevan, Sylvania Electric Products Inc., Los Angeles.

Design Fundamentals and Layout — J. D. Whitnell.

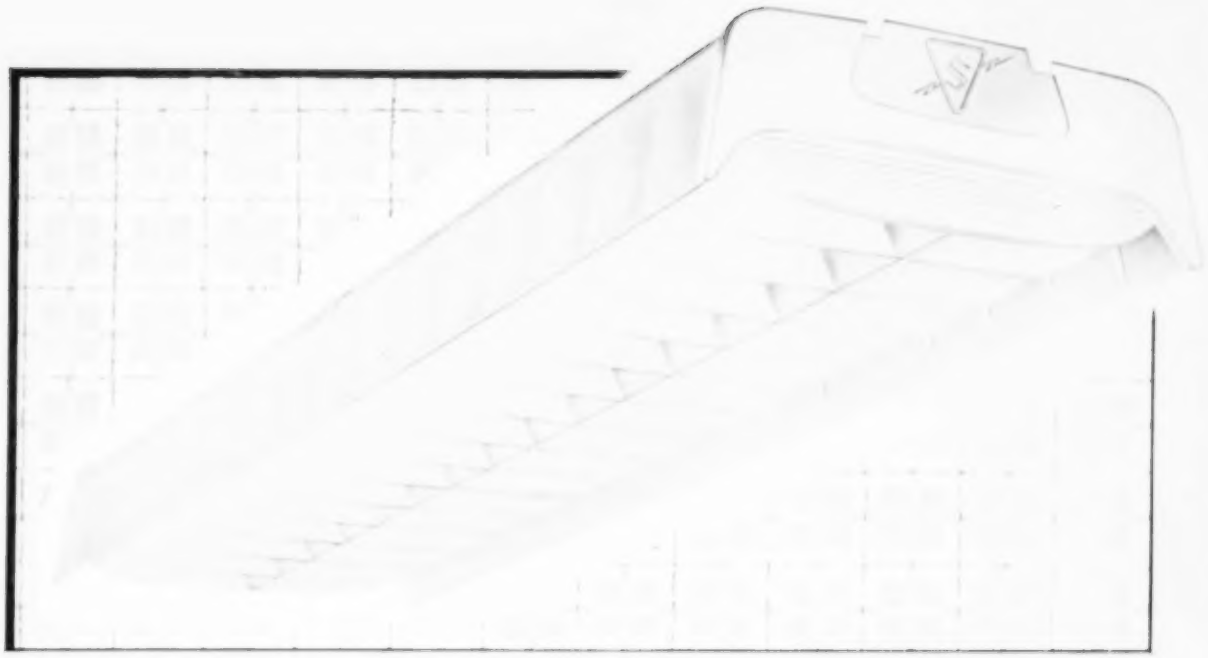
### April 20 — Evening

Lecture Rooms, Classrooms, Library and Reading Rooms — J. R. Williams, Industrial Consultant, Phoenix.

Drafting Rooms — R. Godemann.

(Continued on page 18A)

The report on the Southwestern Regional Conference, at Fort Worth, Texas, April 8-10, will appear in the June issue of IE.



# The Scott... *by Sylvania*

## Now in eye-rest green

### to bring you new dimension in lighting design

TODAY; *color* makes the headline news in lighting design! And this new version of the famous Scott all-luminous fixture by Sylvania—with Eye-Rest Green color blended into its all-plastic shielding—adds the exciting new dimension of *color* to the traditional dimensions of *quality* and *quantity* of lighting.

Visualize the wide new range of creative design possibilities opened up to you! Eye-Rest Green is a cool, comfortable color; suggests an atmosphere of pleasant efficiency. It's a delight to behold—a comfortable sight-saver to work by—something new and different for you to recommend.

The Scott in Eye-Rest Green incorporates all the fine features of the original Scott fixture—high-illumination efficiency, strikingly clean design, and one-piece molded plastic shielding which is light-weight and easy to remove for cleaning and lamp changes.

The Scott in Eye-Rest Green provides ideal lighting for offices, libraries, sight-saving classrooms, close-work areas where comfortable lighting levels are to be maintained. Mail the coupon for complete specification data.

**SYLVANIA** ... fastest growing name in sight

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

**THE SCOTT IN WHITE PLASTIC**
Headliner of this famous Sylvania fixture line, has extremely high 89.8% illumination efficiency.

**SEND COUPON FOR FREE, INFORMATIVE BOOKLETS**

Sylvania Electric Products Inc., Dept. 130
Lighting Division—Fixtures, One 48th Street, Wheeling, West Virginia

- ☐ Please send me complete information on The Scott in Eye-Rest Green.
- ☐ Please send catalog sheets on both versions of The Scott.
- ☐ Have a Sylvania lighting specialist call on me.

Name_____ Title_____

Organization_____ Address_____

City_____ Zone____ State_____

(Continued from page 16A)

Halls, Corridors, Lock Rooms — J. A. Ware, John Allen Ware & Associates, Phoenix.

Shops and Laboratories — James E. Lott, Arizona Public Service Co., Flagstaff.

Cafeterias — Cecil Herren, Arizona Public Service Co., Phoenix.

**April 21 — Morning**

Gymnasiums, Sports Lighting, Protective Lighting — Leonard Turner, General Electric Co., Apparatus Division, Los Angeles.

Auditorium and Stage Lighting — B. H. Hartley, Electrical Engineer, Phoenix.

Economics — Panel Discussion — Moderator: Dick Moriarty, Arizona Public Service Co., Buckeye, Ariz.
Panel — L. L. Pike, Architect, Phoenix; D. Demaree, Electrical Engineer, Phoenix; Marriell Hamilton, New State Electric; J. B. Sutton, School Administrator, Isaac School

## TV Studio Lighting Discussed At SMPTE Convention

Problems of television studio lighting, with special emphasis on the lighting of color productions, was covered during three technical sessions at the 79th semi-annual convention of the Society of Motion Picture and Television Engineers, April 30–May 2 at the Belmont Plaza, New York City, and the Fine Sound Studios.

TV studio lighting engineers, film laboratory technicians, and lighting equipment manufacturers delivered over 25 papers and reports on current developments. Results of two studio lighting surveys conducted by SMPTE Lighting Committee and its Midwest Regional Subcommittee to determine current lighting practice were reported. Light sources were discussed by lamp manufacturers, and techniques of lighting network color productions and locally originated color shows were covered.

**JOINT meeting of the Southern Colorado Chapter and the Rocky Mountain Section attracted 47 I.E.S. members and guests at Colorado Springs, February 6 (above). Photo below shows head table, left to right: Major Charles H. Franks, Public Information Officer, ENT Air Force Base; J. D. Whitnell, Inter-Mountain Regional V-P; W. D. Proudfoot, Chairman, Southern Colorado Chapter; Lynn Carlon, Vice-Chairman, Rocky Mountain Section; and Robert F. Evern, Secretary, Southern Colorado Chapter.**

## Inter-Mountain Region Groups Hold Joint Meeting

A joint dinner meeting, with attendance of nearly 50, was enjoyed, February 6, by the Rocky Mountain Section and the Southern Colorado Chapter of I.E.S. The two groups met halfway at Colorado Springs.

Featured speaker was Regional V-P J. D. Whitnell, who discussed "Local Benefits of the Illuminating Engineering Society." Following this the group toured the Combat Operations Center of the Air Defense Command at the Air Force Base in Colorado Springs.

William D. Proudfoot, Chairman of the Southern Colorado Chapter, presided at the meeting.

## New I.E.S. Region Established Southern Region Divided in Two

With the beginning of the next fiscal year (October 1, 1956) there will be eleven Regions in the I.E.S. organization, with eleven Regional Vice-Presidents representing their members on Council. Action taken by Council at its April 1956 meeting divided the twelve Sections and Chapters formerly constituting the Southern Region into two Regions, to be known as the Southeastern Region and the South Central Region. Boundaries of the Sections and Chapters remain as before. Organization of the two Regions will be as follows:

***Southeastern Region***

Florida Section, Tampa, Fla.
Georgia Section, Atlanta, Ga.
Palmetto Chapter, Greenville, S. C.
Southeast Florida Chapter, Miami, Fla.
Suwanee River Chapter, Valdosta, Ga.
Tar Heel Section, Raleigh, N. C.

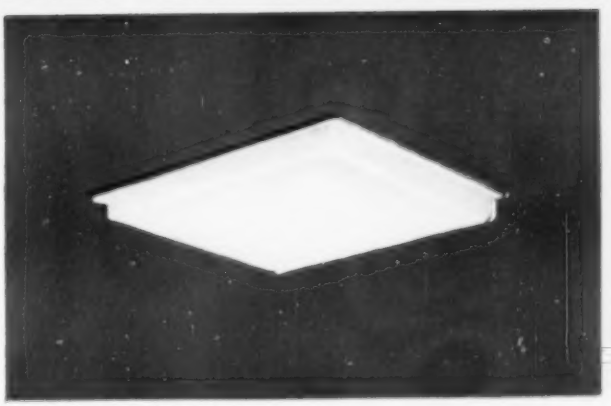
***South Central Region***

Alabama Section, Birmingham, Ala.
Arkansas Chapter, Little Rock, Ark.
Mid-South Chapter, Memphis, Tenn.
Mississippi Chapter, Jackson, Miss.
New Orleans Section, New Orleans, La.
Tennessee Valley Section, Nashville, Tenn.

Effective October 1st, J. D. Mitchell, current Regional Vice-President (South

(Continued on page 20A)

Architects: Johnson, Hatch and Wolff
Electrical Engineer: J. S. Hamel



# For permanence . . . quality beauty . . . PLEXIGLAS

Throughout the reading areas of the new San Diego Public Library, fluorescent fixtures with large formed diffusers of PLEXIGLAS provide low-brightness, high-level lighting.

Here are the reasons for the constantly increasing use of PLEXIGLAS acrylic plastic in lighting:

PLEXIGLAS provides superior transmission and diffusion of light. It is rigid, strong and durable, with exceptional freedom from discoloration on long exposure to fluorescent lamps. In outdoor lighting, it provides time-proved resistance to weather.

Lighting engineers and architects specify PLEXIGLAS for diffusers on large-area indoor and outdoor fixtures, and for luminous ceilings, when they want the permanence, strength and beauty that add up to illumination of the highest quality.

*PLEXIGLAS is a trade-mark Reg. U.S. Pat. Off. and in principal foreign countries*

*Chemicals for Industry*

## ROHM & HAAS COMPANY

**Washington Square, Philadelphia 5, Pa.**

*Representatives in principal foreign countries*

**Canadian distributor:** *Crystal Glass & Plastics, Ltd., 170 Queen's Quay at Jarvis Street, Toronto, Ontario, Canada*

---

**Rohm & Haas Company**
Washington Square, Philadelphia 5, Pa.

Please send me ☐ "Architectural Lighting with PLEXIGLAS"
☐ "Outdoor Lighting with PLEXIGLAS"

**Name**

**Firm**

**Address**

**City** **Zone** **State**

(Continued from page 18A)

ern Region) will continue his term as Regional V-P serving as Vice-President of the new Southeastern Region. Council will appoint a Regional Vice President to serve the South Central Region for a term starting October 1st. Re-appointment of this new Regional Vice President in the following year 1957-1958 has been recommended to provide Regional Vice-President elections on an alternate year schedule in these two Regions.

For the present, it is planned to hold joint Regional Conferences, Sections and Chapters of both Regions participating in a single meeting.

## Applied Solar Energy — Subject of New Newsletter

The Association for Applied Solar Energy has begun initial world distribution of its newsletter, "The Sun at Work." The quarterly publication will serve to establish and maintain contact among persons concerned with solar energy research. Its purpose is to publish news of association activities as well as information about people and developments in the field of solar research. Guy Benveniste, Stanford Research Institute economist, is editor.

The first mailing of "The Sun at Work," consisting of 10,000 copies, was sent to scientists, engineers, architects and industrialists in 37 countries. Many of these people had attended the World Symposium on Applied Solar Energy held last year in Phoenix, Ariz. The newsletter's name is derived from the title of the Solar Engineering Exhibit held in conjunction with the symposium.

The association also has plans to issue "The Journal of Solar Energy Research" as a scientific publication for original papers and for extensive abstracts of contributions previously printed elsewhere. Other current activities of the association include the operation of a solar energy library and the establishment of a museum of solar energy research.

# Operation I.E.S.

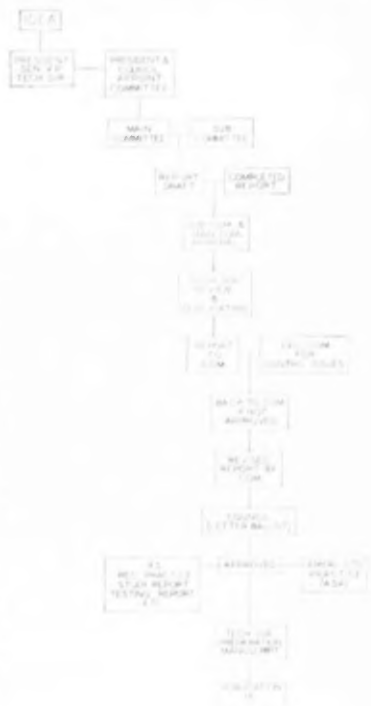
## Technical Committee Reports, Where They Come From, How They Develop

Development of Technical Committee Reports — authoritative guides for all phases of lighting — is one of the most important functions of the Illuminating Engineering Society. How do they start? How do they develop, and who prepares them?

Specific subjects on which information has shown itself to be needed are assigned to committees for study and preparation of reported recommendations. Committee personnel is made up of top experts in the subject studied, with scope of the committee being outlined by the Council of I.E.S., and personnel appointments being made by Council. Their work, committee meetings, and all of their reports are under the guidance of the Technical Director.

All reports start from a specific need or request for information on certain technical subjects. From this an *idea* is born and a routine procedure in the development of a report is followed as depicted in the accompanying chart. As an example, just recently the Society received a request suggesting that an authoritative up-to-date report was needed on lighting gasoline service stations. The request was referred to the President, who discussed it with the Senior Vice-President (in charge of technical activities) and the Technical Director. The matter was referred to the Store Lighting Committee, who established a subcommittee on "Lighting of Parking Areas and Service Stations" for study and report. Personnel of this subcommittee is, of course, men highly knowledgeable in service station and parking area lighting.

Sometimes requests for technical reports come from the Technical Committee Forum, which is a group made up of the



above-mentioned officers and all the technical committee chairmen. The Senior Vice-President is Chairman of this Forum, and calls the entire group to meet each Fall to plan the year's technical program and correlate each other's work. Those who have attended or witnessed one of these Forums agree that the "technical brains" of the Society are assembled in all their glory, participating in an impressive program for a most important activity.

In the final analysis, the President requests Council to approve establishment of a new committee, or as in the example cited, refer the study to an existing committee for action.

Once the idea has been approved for study, it follows an interesting procedure toward completion (see chart). After its delegation to a committee or subcommittee, usually many related points are discussed in committee meetings and put into draft form. Generally an outline is made of the items to be covered, perhaps the sequence of steps in an industrial process, for example, or the locations in an institution or commercial establishment. Then assignments are made to members of the committee (or to subcom-

(Continued on page 21A)

## I.E.S. National Technical Conferences

1956 — September 17-21 — Hotel Statler, Boston, Massachusetts

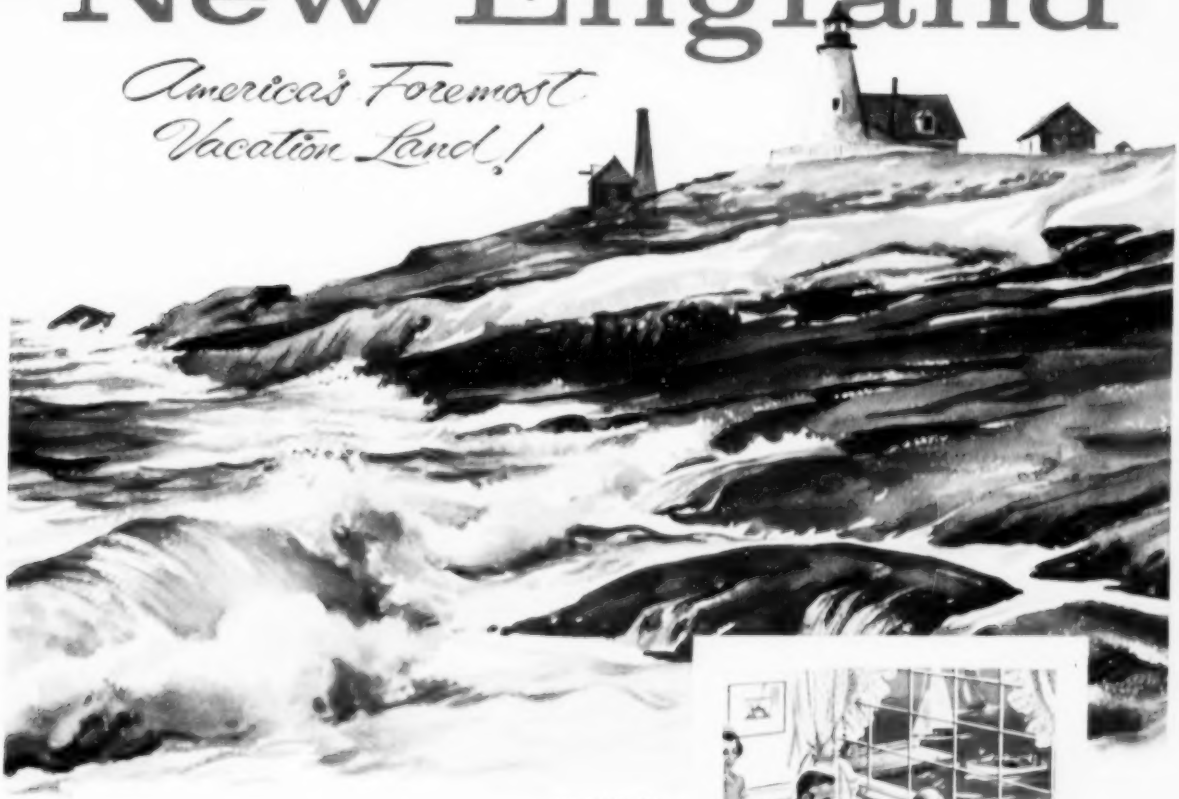
1957 — September 9-13 — Biltmore Hotel, Atlanta, Georgia

1958 — August 17-22 — Royal York Hotel, Toronto, Ontario

1959 — September 7-11 — Hotels Fairmount and Mark Hopkins, San Francisco, California

# New England

*America's Foremost Vacation Land!*



## Welcomes...

# I.E.S.'s

*Golden Anniversary Conference*

HOTEL
STATLER
BOSTON

SEPTEMBER 17–21

# Illuminating Engineering Society

*1860 Broadway, New York 23, N. Y.*

OFFICE OF THE PRESIDENT
1955-56

May 15, 1956

To Members of I.E.S.

1956 marks the 50th Anniversary of the Illuminating Engineering Society. A half century ago our very first Section was chartered—IN NEW ENGLAND. The next year our first technical conference was held—IN BOSTON. It is not mere coincidence then, that finds us, this year, returning to our birthplace for our 50th Anniversary technical conference.

The importance of this conference is emphasized by the especial excellence of the technical sessions, by the historical significance to our own group of the place and the year, and of course by the inevitable appeal of New England itself.

It is a pleasure to extend the cordial invitation of the Society to each of you to join us in Boston in September.

Cordially,

R B Austerstein

(Continued from page 20A)

mittees if the overall committee is large). The individual (or chairman of the subcommittee) prepares the text to reflect the latest information and techniques regarding the lighting of the area or the locations where important visual tasks are carried on. Critical tasks are isolated and an analysis made of the lighting to best portray detail. Visibility measurements are made and illumination recommendations determined. Arrangements of lighting equipment are designed to fulfill the requirements determined in the task analysis.

Sometimes several drafts are redrawn before a final draft is accepted by the committee. After committee approval of the final draft, however, it goes to the Technical Director for review and possibly correction. Sufficient copies of it are duplicated to send to every member of the main committee and the subcommittee responsible for preparing it. This gives all committee members a good perpective on what the final report will be, and another chance to comment or revise.

There are times when certain points in a report may become controversial among committee members. Where such may be the case, regardless of whether the controversy is of minor or major significance, the Executive Committee receives the report for comment, clarification and resolution of the controversial points. The report in such instances goes back to the committee for reconsideration, and rewritten agreement. With final committee approval, the report is presented to Council. If not approved by Council, it is again returned to the committee, with Council's comments. Once more the committee must study suitable revisions, and resubmit the report to Council.

After Council gives approval at one of its regular meetings, the duplicated report is sent to all Council members for letter ballot and final approval. Failure to receive approval from this balloting simply means the report is returned once more to committee for study and revision.

Full approval by two thirds favorable vote from letter ballot of Council must be received before a report is approved for publication. Preparation of final manuscript of reports approved for publication in ILLUMINATING ENGINEERING and in booklet form, is the responsibility of the Technical Director.

To relate a specific example of the birth and development of a report, a short time ago an inquiry was made by a redwood lumber mill to the local power company for information on suitable lighting for the inspection of redwood lumber defects. The lighting department wrote to I.E.S. headquarters for information. The Technical Office suggested that since there was practically nothing available on this subject, it would be a good opportunity for service to the redwood industry and to the Society, to conduct a local study project. Soon a local committee was established consisting of representatives of the redwood industry, university vision and illumination specialists, state forestation, and lighting industry. They started work as a subcommittee of the Industrial Lighting Committee. To date two excellent reports have been submitted to Council, have been approved, and are now in the hands of the Technical Director for final preparation. Excellent redwood industry satisfaction has been established.

In effect, there are five types of technical reports, all of them eventually made available to members of the Society and others interested in the various phases of illumination. They are: Recommended Practices, Study Reports, Testing Reports, Calculation Reports, Educational Reports.

*Recommended Practices* — These are the most familiar, and perhaps the most widely used of the Society's committee reports. Currently Recommended Practices are available for Office Lighting, School, Industrial, Residential, Street and Highway Lighting, and Daylighting Practice. Also for Supplementary Lighting and Store Lighting. Revision of Recommended Practices occurs periodically. Generally the committee involved first recognizes the deficiencies of the

(Continued on page 24A)

# LIGHTING CALENDAR

## Society Events

**September 17-21, 1956** — Illuminating Engineering Society, National Technical Conference, Hotel Statler, Boston, Mass.

**September 9-13, 1957** — Illuminating Engineering Society, National Technical Conference, Biltmore Hotel, Atlanta, Ga.

## Industry Events

**June 4-7, 1956** — Edison Electric Institute, 24th Annual Convention, Atlantic City, N. J.

**Week of June 10, 1956**—National Association of Electrical Distributors (48th Annual Convention), Ambassador Chelsea Hotels, Atlantic City, N. J.

**June 11-15, 1956** — Technical Conference on Plastics, New York Coliseum, New York, N. Y.

**June 25-29, 1956** — American Institute of Electrical Engineers, (Summer & Pacific General Meeting), San Francisco, Calif.

**June 27-July 5, 1956**—International Electro Technical Committee, Munich area of Southern Germany.

**October 1-5, 1956**—American Institute of Electrical Engineers (Fall General Meeting), Morrison Hotel, Chicago, Ill.

**October 2-4, 1956**—Canadian Electrical Manufactureres Association (12th Annual Meeting) Sheraton Brock Hotel, Niagara Falls, Ontario, Canada.

**October 7-12, 1956** — Society of Motion Picture and Television Engineers, Ambassador Hotel, Los Angeles, Calif.

**October 22-24, 1956** — American Standards Association, 38th Annual Meeting (In conjunction with Seventh National Conference on Standards), Hotel Roosevelt, New York, N. Y.

**October 22-26, 1956**—National Safety Council, 44th National Safety Congress & Exposition, Chicago, Ill.

**November 12-16, 1956**—National Electrical Manufacturers Association (Annual Meeting), Traymore Hotel, Atlantic City, N. J.

**January 21-25, 1957** — American Institute of Electrical Engineers, Winter General Meeting, Hotel Statler, New York, N. Y.

**February 17-20, 1957** — National Electric Sign Association, Annual Convention and Exhibit, Sheraton Park Hotel, Washington, D. C.

**March 11-14, 1957** — National Electrical Manufacturers Association, Edgewater Beach Hotel, Chicago, Ill.

**May 6-8, 1957** — Air Conditioning and Refrigeration Institute, Annual Meeting, The Homestead, Hot Springs, Va.

**May 7-9, 1957** — Chicago Electrical Industry Show, Chicago, Ill.

**June 24-28, 1957** — American Institute of Electrical Engineers, Summer General Meeting, Montreal, Que.

**August 28-30, 1957** — American Institute of Electrical Engineers, Pacific General Meeting, Yakima, Wash.

**October 7-11, 1957** — American Institute of Electrical Engineers, Fall General Meeting, Chicago, Ill.

**October 21-25, 1957** — National Safety Council, 45th National Safety Congress & Exposition, Chicago, Ill.

**November 11-15, 1957** — National Electrical Manufacturers Association, Traymore Hotel, Atlantic City, N. J.

current Practice and advocates that revision begin. Most recent example of this is the revision of the Office Lighting Practice, scheduled for publication in the June issue of IE. To illustrate the thoroughness and hard work that goes into such a revision, it might be noted that the Office Lighting Committee composed of 17 members, held over 20 meetings in the revision of the 1947 Office Lighting several cities over the past five years, for Practice. Some of these meetings were two-day sessions and many a meeting lasted on toward midnight.

Many of the Recommended Practice reports are prepared with a view toward later approval as an American Standard Practice, after their review and approval by the American Standards Association.

*Study Reports* — These are specific studies of more or less special applications. Examples currently available are: Transportation Lighting, Library Lighting, Control and Dispatch Room Lighting, Bakeries, Canneries, Flour Mills, Foundries, Small Metal Parts, Steel Mills, Wooden Mills, etc.

*Test Reports* cover a series of "finides" for electrical and photometric measurements of lamps and luminaires including incandescent, mercury, sodium and fluorescent light sources.

*Calculation Reports* are illustrated by the new "Calculating Coefficients of Utilization" published in this issue of ILLUMINATING ENGINEERING.

*Educational Reports* are developed by the Lighting Education Committee for use in schools and for Section and Chapter courses on Illumination. "Experiments with Light" for secondary schools, has recently been revised and approved by Council.

Who uses the Society Reports. Numerous people and organizations? Among them are consulting engineers, architects, specifiers of lighting, industrial concerns, contractors, colleges, and many others. For instance, about three years ago, the National Office Management Association purchased 14,000 copies of the 1947 Office Lighting Practice for distribution to its members throughout the country.

Yes indeed, the birth of a report stemming from an *idea* very often has a rough row to hoe in its development before becoming an I.E.S. publication. No single individual or company has any influence in directing opinions in any of these reports, because of the many individuals who come from all phases of the lighting profession and industry.

This is just another reason why our Society is so highly recognized as an authority, and why every member may be proud of its achievements these past 50 years. GEORGE J. TAYLOR, *General Secretary*

## French I.E.S. Schedules June Conference in Tours

The Society's sister organization in France, the Association Francaise des Eclairagistes, has scheduled its annual conference in Tours, France, June 5 to 9. I.E.S. members in the United States and Canada are welcomed to attend.

A varied program of technical sessions has been planned, including school lighting; photographic and motion picture lighting; the use of plastics in luminaires; accessories; and reports on lighting installations in Brussels, Geneva, Paris and Le Havre. Field trips to installations in the Tours area have been arranged.

## Panhandle Chapter Receives "Bluenose" Gavel

In keeping with the I.E.S. tradition of the newest Chapter receiving a special gavel from the next to newest, the Panhandle Chapter (Amarillo, Texas) was sent a gavel, recently, by the Bluenose Chapter (Halifax, N. S.). The distance between the two groups did not permit an "in person" presentation at the March 26 meeting, but Tom Hart, immediate past chairman of the Texas group, acted as proxy for the Nova Scotians. Chairman C. R. McCracken received the gavel for the Chapter.

Accompanying the gift was a letter describing it, which reads, in part:

"Having due regard to the vastness of Texas, and to the legendary prowess of her men, we had some thought of offering a fence post mallet. However, when we considered the cost of shipping, the native reluctance to part with 'siller,' which is a heritage from the Scottish ancestors of many Nova Scotians, prevailed; and we have sent you a gavel of more modest size.

"The head of the gavel is made of apple wood from the great orchards of the Annapolis Valley — the 'Land of Evangeline,' opening scene of Longfellow's poem. The haft is of cherry wood, from the orchards at Bear River. The Amethyst tipping the shaft is from Cape Blomidon, ancient haunt of Glooscap, the 'great spirit' of the Micmac Indians.

"The name 'Bluenose' is the traditional nickname of the native Nova Scotian, a nickname sometimes regrettably expanded to 'Bluenose Herring Choker.' Hence, the pride of Nova Scotia, the International Champion fishing schooner, was also called the 'Bluenose,' and so we have called our Chapter.

"The form of the head of the gavel

(Continued on page 27A)

**PANHANDLE CHAPTER Chairman C. R. McCracken, left, Amarillo, Texas, receives the gavel sent as a gift from the Bluenose Chapter, Halifax, Nova Scotia. Tom Hart, immediate past chairman of the Chapter, had the honor of presenting the gavel, in the absence of any members from Nova Scotia.**

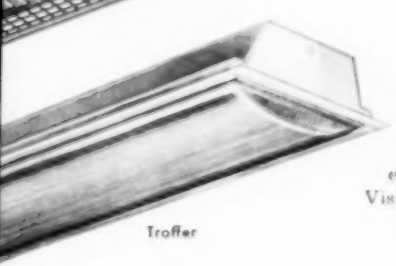
# For Modern SCHOOL LIGHTING

long experience + latest design + widest line = LPI

Optic-Ease

Educator

Thin-Lite


Troffer

## LPI Pioneered...
## Now Leads the Field

- Continuously specializing in fluorescent lighting since its origin.
- Distinctively advanced, exclusive and functional design.
- The widest range of luminaires, calculated to fit *every* school's needs.
- Highest quality—that assures simple installation, ease of maintenance, high efficiency.

BEFORE YOU *SPECIFY*... CHECK WITH LPI

***Mail This Coupon Today***
for LPI's Brochure on Modern School Lighting entitled "A Lifetime of Good Vision Begins in the Classroom."

**LIGHTING PRODUCTS INC.** Dept. 6A Highland Park, Ill.

*Please send me your new brochure on Modern School Lighting entitled "A Lifetime of Good Vision Begins in the Classroom."*

Name _____ Position _____

Company _____

Address _____

City _____ Zone _____ State _____

6760

# appearance IS ONLY half THE STORY!

You'll find the whole story in Smithcraft's "Architectural Troffers" Handbook. Write for your copy today!

*Patent 2,597,875 other patents pending

New Smithcraft Architectural Troffers . . . fixtures which assure superlative lighting and clean, trim, uncluttered ceilings. There are no visible catches, latches, hinges, bolts or screws to mar the finished effect . . . and the wide choice of sizes and shielding have made Smithcraft the inevitable choice wherever outstanding appearance is desired.

However, equally important is the other half of the story . . . the exclusive "hidden" features that provide the unlimited versatility, high efficiency and cost-chopping economy in both installation and maintenance. For example, Smithcraft's patented Yoke-Aligner* so effectively simplifies installation that only a screwdriver is needed from start to finish! Developments like these are just as important to the architect and engineer as are Smithcraft's outstanding lighting performance and appearance.

**Smithcraft** LIGHTING DIVISION, CHELSEA 50, MASS.

AMERICA'S FINEST FLUORESCENT LIGHTING

(Continued from page 24A)

was therefore adapted, though much compressed, from that of a caulking mallet, such as was used in building the Schooner. The 'silver discs, bearing in low relief likeness of a fishing schooner,' set in the square boss near the tip of the haft, are, of course, Canadian ten cent pieces. The schooner is, however, actually the Bluenose.

"With the gavel we send a map of Nova Scotia, embellished with a few boasts; and various notes which we hope will be both amusing and informative.

"We also send a number of pictures, illustrating points which are marked on the map; and a small silk Nova Scotia flag. Nova Scotia is the only Province of Canada which has, by Royal Charter, the right to fly her own flag — a blue Saint Andrew's Cross on a white field, with the Royal Lion of Scotland, red, on a golden shield, at the centre. The flag is a gift from the Government of Nova Scotia."

**LIGHTING REFRESHER COURSE was a big success in Tampa, co-sponsored by the Florida Section of I.E.S. and the Lighting Department of the Tampa Electric Co. Total attendance for five meetings was 481.**

## California Maintenance Engineers Sponsor Electrical Industry Show

The eighth biennial Electrical Industry Show, sponsored by the Electrical Maintenance Engineers Association in Southern California, was held April 5-7 at Shrine Exposition Hall in Los Angeles. Latest developments in incandescent and fluorescent lamps, gear and shaft motors, push button ventilating range hoods, window ventilating fans, explosion proof drop and floodlights, automatic time recorders and other items in the electrical field were shown.

Edmund McKanna, of the Los Angeles Planning Commission, gave the principal address at the kick-off luncheon, "The Future of Southern California Industry."

## Lighting Refresher Course A Big Success in Florida

A refresher course, consisting of five meetings covering those phases of lighting most frequently encountered by men in the field, was recently co-sponsored by the Florida Section of I.E.S. and the Tampa Electric Co.

Total attendance was 481 for the five meetings, with 67 attending the four necessary to graduate, and receiving parchment diplomas suitable for framing.

Topics and speakers were:

(1) Need for Better Lighting and What Are We Going to Do About It — J. A. Banton and George N. Jack.
(2) Lighting Calculations and Fundamentals — Frank Moss.
(3) and (4) Store and Office Lighting — J. A. Banton.
(5) Industrial, Church, School and Outdoor Lighting — James M. Ketch.

The meetings were held in the Auditorium of the new Chamber of Commerce Building in Tampa, from 7:30 to 9:30 p.m. Those in attendance included electrical contractors, architects, engineers, wholesalers, fixture representatives and utility personnel, all of whom voted for an advanced course in the Fall.

## Maintenance Contractors Hold Third Annual Conference

The National Association of Lighting Maintenance Contractors held their third annual conference at Hershey, Pa., April 18th, at which new officers were elected.

Edward Creed of Cleveland was elected President and Herbert Mendelsohn of Kansas City will serve as Secretary-Treasurer of the organization. Regional Vice-Presidents are:

Eastern — Francis Clark, Waterbury, Conn.
Southern — Walter Fink, Jr., Atlanta, Ga.
Central — Jerome Gimbel, Chicago, Ill.
Mid-Western — Glen Shatola, Milwaukee, Wis.
Western — Robert Watson, Denver, Colo.

Also on the agenda were talks by Robert Zahour, Westinghouse Electric Corp., John Holland, Sylvania Electric Products, Inc., and Richard Lundgren, General Electric Co. Sales and advertising discussion was led by Robert and James Watson; office procedures were presented by Herbert Mendelsohn.

Round table discussions covered personnel, wages, bonus, uniforms and training, group replacement profits and service methods.

Kansas City was approved as the site for the 1957 conference to be held during the month of April.

## Student Activities At University of Miami

With the Engineers' Exposition (see April IE, page 9A) behind them, the I.E.S. Student Branch at the University of Miami is preparing for the official dedication of the A. C. Bergh Illuminating Laboratory. The laboratory is dedicated to the memory of the late August C. Bergh, who was instrumental in the formation of the Student Chapter at the university.

The Student Branch is holding weekly meetings and keeping its members informed of activities by means of a duplicated newsletter.

## Annual Lighting/Wiring Courses Presented by CLI

The lecture-laboratory course on Lighting Fundamentals and the Wiring Design Course, annual events at the Chicago Lighting Institute, are again being co-sponsored by the Institute, the Chicago Section of I.E.S., and the Illinois Institute of Technology.

The Institute, which has moved to the Marquette Building at 140 South Dearborn St., will eventually occupy much of the second floor of the building, which is now being designed for their requirements. In the meantime, the offices of CLI are in rooms 653, 654 and 655; the classroom and laboratory are in room 1763.

(Continued on page 28A)

## Residence Lighting Resource List Available from Headquarters

A 29 page bibliography, compiled by the I.E.S. Residence Lighting Committee, entitled the Residence Lighting Resource List, is available free of charge from the I.E.S. Headquarters Office, Technical Department.

The list was compiled especially for educators, home advisors and students of home lighting as a guide to current authoritative sources of associated study, research, development and recommended practice. Titles and a short description of each publication are classified according to the following categories: nature of light, light and vision, light sources, luminaires, lighting design principles, recommended lighting methods, housekeeping functions, architecture, interior design and furnishings, color, wiring and visual and teaching aids.

## ABOUT PEOPLE

**Dr. Clifton G. Found,** for nine years Research Director for General Electric Lamp Division, and its Technical Advisor since 1951, retired from active service March 30, after more than 40 years with the company. Following an extended vacation trip, Dr. Found will reside permanently in Bay City, Mich.

**John J. Neidhart,** Fellow of I.E.S., has accepted a position as Applications Engineer with the Miller Co., Meriden, Conn. Mr. Neidhart was formerly with Westinghouse Electric Corp. in Cleveland, Ohio.

**Francis D. Wyatt,** Consulting Electrical Engineer specializing in street lighting, announces a new address at 427 Cottage Hill Ave., Elmhurst, Ill. Mr. Wyatt, a Fellow of I.E.S., was with the Chicago Park District prior to his retirement last year.

**Dr. Clinton R. Hanna,** electromechanical systems inventor and associate director of research, Westinghouse Electric Corp., East Pittsburgh, Pa., has been awarded the 1955 Lamme Gold Medal by the American Institute of Electrical Engineers. The medal has been awarded to Dr. Hanna "for his fundamental calculations and developments in the field of electrodynamics and particularly for his achievements in the design of generator voltage regulators, automatic rolling mill controls and tank gun stabilizers." Presentation of the medal will be made at the Summer General Meeting of AIEE in San Francisco.

**George M. Stapleton** has been elected Vice President and also Manager of Dimmer Sales of Ward Leonard Electric Co., Mount Vernon, N. Y. Mr. Stapleton has been Manager of Engineering since 1948. He succeeds **A. W. Borghard,** who has retired after 36 years of service with Ward Leonard.

**Dr. George W. Howard** has been promoted to fill the newly-created position of technical director at the Corps of Engineers' Research and Development Laboratories, Fort Belvoir, Va. He will serve as assistant to the Director, Col. H. F. Sykes, Jr., in guiding the program of basic and applied research, engineering design and development, and test of Engineer equipment. Prior to this promotion, Dr. Howard was Chief of the Laboratories' Technical Service Department. He was a 1953 winner of the Rockefeller Public Service Awards made to outstanding careerists in government.

**Frank B. Lee** has been appointed District Engineer of General Electric Co.'s South Pacific Sales District, with his headquarters at 3450 Wilshire Blvd., Los Angeles. Mr. Lee was formerly with G E in Cleveland.

Pittsburgh Reflector Co. has appointed **Donald D. Murray** as lighting representative for their Eastern Missouri, Southern Illinois and Western Kentucky territory. Mr. Murray will have his headquarters at 6148 Washington Blvd., St. Louis 12, Mo.

**William J. Roach** has joined the Public Relations Department of Sylvania Electric Products, Inc., as a project manager, and will be located at the company's executive offices in New York City.

Announcement has been made of the appointment of **Seymour W. Brody** as Vice President of the Cold Cathode Lighting Corp. Mr. Brody was formerly Staff Executive General Engineer for the Directorate of Development, Wright Air Development Center, United States Air Force.

The Thompson Electric Co. announces that the Wynne Snoots Co. of Dallas, Texas, has ben selected as its sales representative in the state of Texas. In addition to its Dallas office, under the direction of **Wynne Snoots** and **Robert E. Wood, Jr.**, the company has branch offices in Houston, managed by **Ray LeMaster,** and in Lubbock, **Stewart Norris,** manager.

**Stan Heywood,** formerly a sales engineer in the Los Angeles area for Prescolite Manufacturing Corp., has been appointed Eastern Sales Manager. He is making his headquarters in the Neshaminy, Pa., plant of the company.

### Watch for June IE

The June issue of IE, with the new Recommended Practice for Office Lighting, will feature various aspects of lighting in offices and associated areas.

The Miller Co., Meriden, Conn., has announced the appointment of several sales representatives. **Robert W. Ellis** has been named representative in Eastern Massachusetts, Rockingham County in New Hampshire and the State of Maine. Mr. Ellis was formerly sales representative for the Litecontrol Corp. **William J. Byrne** has been appointed to the Upper New York State territory. Mr. Byrne formerly with Smitheraft Lighting in this area. **William D. Faust,** formerly with Walker Electric Co., has been named sales representative for Southern Louisiana, Mississippi and Alabama, with headquarters in New Orleans. The company will be represented in the Chicago area by **Richard G. Vacca,** who prior to this appointment had been with Sylvania Electric Products Inc.

The addition of **Arthur O. Williams** to the Peerless Electric Co., San Francisco, staff of lighting sales engineers has been announced. Mr. Williams has been assigned to augment the San Francisco-Oakland Bay area sales personnel.

**William G. Lynch** has been named Sales Manager of the Neon Ignition Division of Jefferson Electric Co., Bellwood, Ill. Mr. Lynch has been with Jefferson for 14 years and was formerly Assistant Sales Manager.

Moe Light Division of Thomas Industries Inc. has appointed three new sales representatives. **William Edwards** is the representative in Albany, N. Y.; Hartford, Conn.; Vermont and parts of Massachusetts and Rhode Island. His headquarters are in Springfield, Mass. **William Bassett** will work out of Omaha, Neb., with a territory covering most of Iowa and about half of Nebraska. **Rollo Hittle** will represent the firm in the greater Los Angeles metropolitan area.

The Society of Motion Picture and Television Engineers has appointed **Miss Sue Grotta** as Director of Press Relations. From SMPTA headquarters in New York City, Miss Grotta will direct the program of public information, including a technical information service.

*(Continued on page 31A)*

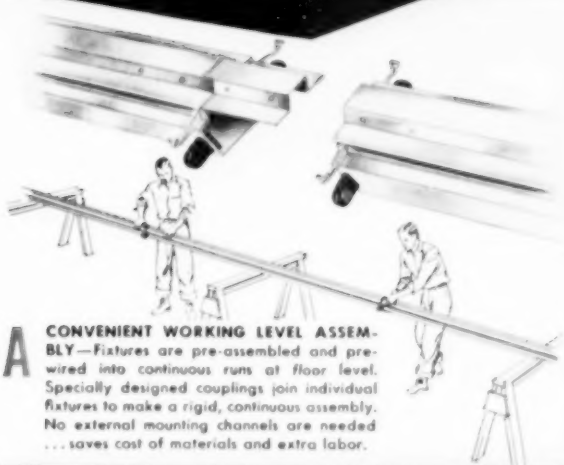
THIS IS THE GARCY
Speed-Line®
PATENT PENDING
SYSTEM
optional at no extra cost with Garcy Visualier and Gar-See-Lite Fixtures

# School gets premium lighting at saving of $4482 with GARCY Speed-Line®

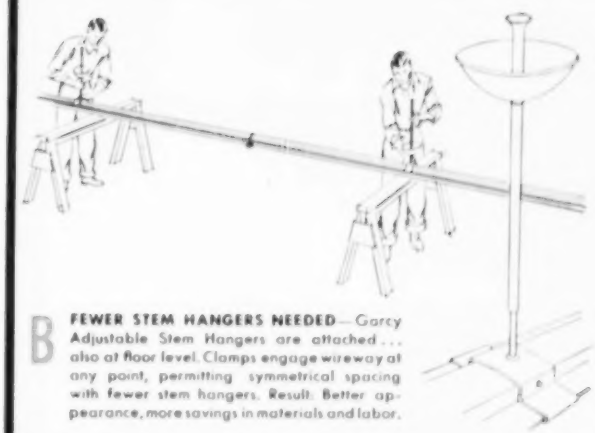
The potential savings of the Garcy *Speed-line* System were well known to E. F. Klingler & Associates, architects, who supervised the job of relighting the Eau Claire Senior High School. All bidders for the lighting contract were invited to submit an alternate figure based on *Speed-line* savings. In the successful bid, *Speed-line* savings were figured at $4482 . . . a cost reduction representing *more than half the installation labor costs*, plus the elimination of external mounting channels. This saving permitted the installation of the finest in school lighting . . . Garcy Visualiers . . . at far less than the cost of ordinary fixtures.

*Learn how* Speed-line *is reducing installation labor costs . . . in some cases as much as 90% . . . on continuous-run lighting.*

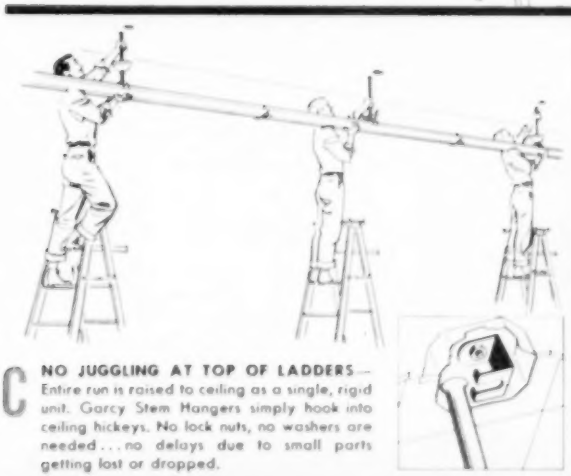
**Send today for Bulletin 551-L**



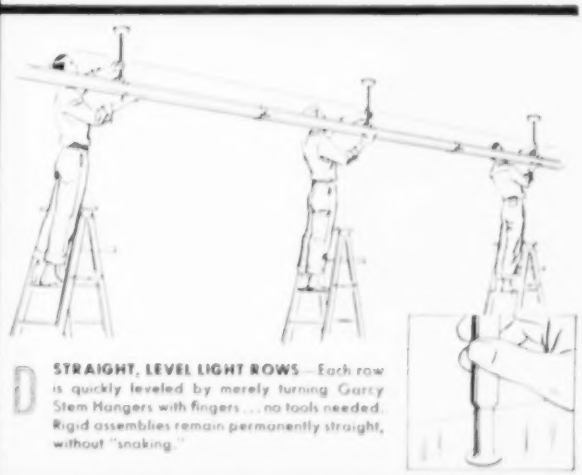
**A CONVENIENT WORKING LEVEL ASSEMBLY**—Fixtures are pre-assembled and pre-wired into continuous runs at floor level. Specially designed couplings join individual fixtures to make a rigid, continuous assembly. No external mounting channels are needed . . . saves cost of materials and extra labor.



**B FEWER STEM HANGERS NEEDED**—Garcy Adjustable Stem Hangers are attached . . . also at floor level. Clamps engage wireway at any point, permitting symmetrical spacing with fewer stem hangers. Result: Better appearance, more savings in materials and labor.



**C NO JUGGLING AT TOP OF LADDERS**—Entire run is raised to ceiling as a single, rigid unit. Garcy Stem Hangers simply hook into ceiling hickeys. No lock nuts, no washers are needed . . . no delays due to small parts getting lost or dropped.

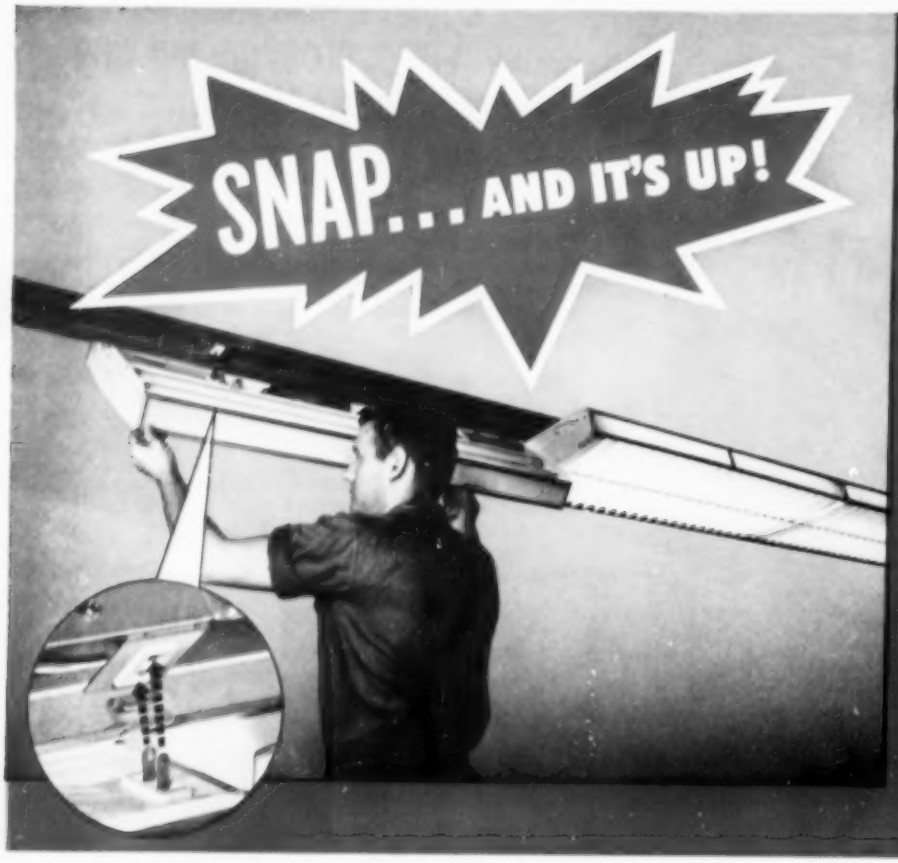


**D STRAIGHT, LEVEL LIGHT ROWS**—Each row is quickly leveled by merely turning Garcy Stem Hangers with fingers . . . no tools needed. Rigid assemblies remain permanently straight, without "snaking."

**Send today for Bulletin 551-L**

**GARCY** *Quality by Design*

GARDEN CITY PLATING & MFG. CO., 1760 N. Ashland Ave., Chicago 22, Ill. *In Canada:* Garcy Co. of Canada, Ltd., 191 Niagara St., Toronto



**1** Telescoping sections of UNI-RACE assembled and wired on the floor.

**2** UNI-RACE, in 24' to 48' assemblies, can be hung from bar joists, I-beams or stems.

**3** Fixtures snapped into place in seconds without tools.

# HERE'S BETTER LIGHTING AT HALF THE COST

## FEATURES THAT DEFY COMPARISON

- **ON-JOB POWER SOURCE** Before fixtures are installed, receptacles in UNI-RACE provide power source for tools and temporary lighting.
- **NO FIXTURE STORAGE** Fixtures need not be delivered until premises are painted. The units can then be snapped into place—clean and factory fresh.
- **VARIABLE SPACING** Fixtures can be mounted in continuous rows or at intervals of 4, 8, 12 or more feet—added, removed or respaced at any time.

The Gibson ORTHO Fixture is a completely new concept in commercial and industrial lighting design. The exclusive UNI-RACE, shipped separately from the fixtures, provides straight alignment, exact fixture spacing and a fixed power source (receptacle) for each fixture. It banishes those pesky aligning problems and eliminates all electrical work on the fixture itself—just take the units as they come from the box and snap into place at any desired interval of 4' or 8' on the UNI-RACE.

All of which adds up to a 50-percent saving in labor and material—often more—unheard of flexibility to the user, and gives you a better-looking, higher-quality job.

There are many other advantages you ought to know about. Drop us a line today, we'll gladly send you complete information about the remarkable new ORTHO-77 and 88 for commercial and industrial applications.

Gibson LIGHTING

GIBSON Manufacturing Co.

1919 Piedmont Circle, N.E., Ellerslee-3291, Atlanta 5, Georgia

(Continued from page 28A)

The promotion of **Noel C. Bride** to district lighting sales manager of the Washington, D. C., district by Sylvania Electric Products has been announced. He is making his headquarters at the company's offices at 2529 Oakville St., Alexandria, Va. Mr. Bride succeeds **G. Dallas Rand**, who was recently appointed manager of lighting sales by Sylvania.

## OBITUARIES

**Dr. E. C. Crittenden**

**Dr. Eugene Casson Crittenden,** one of the Society's most distinguished members, died March 28 from cancer. Dr. Crittenden, a Past President (1924-1925) had received every honor which the Society can bestow. One of the first ten members to be elected to Fellow grade, on its inception in 1924, he was also the recipient, in 1946, of the highest award in the field of illumination, the I.E.S. Gold Medal.

Dr. Crittenden is perhaps best known for his achievements in the development and adoption of electrical and photometric standards. As Vice-President of the International Commission on Illumination, from 1939 to 1948, and President of the U. S. National Committee from 1928 to 1935, he played a major role in the establishment of modern photometric units, standards and methods of measurement which culminated in the international adoption of the "candela" in 1948. As the United States representative on the International Committee on Weights and Measures from 1946 to 1954, its Vice-Chairman from 1950 to 1954, and Chief of the National Bureau of Standards' Electrical Division for many years, he was a leading scientific figure in replacing the obsolescent international system of electrical units by the so-called absolute electrical units.

Associated with the National Bureau of Standards for over 40 years, Dr. Crittenden was awarded, in 1949, the Department of Commerce Gold Medal Award for Exceptional Service. On his retirement in 1951 as Associate Director of the Bureau, he was elected a Member Emeritus of I.E.S. He continued to serve the Bureau as Consultant to the Director up to the time of his illness.

In addition to his service on many I.E.S. committees, he was active in other scientific and professional organizations, the American Standards Association, the U. S. National Committee of the International Electrochemical Commission, the Optical Society of America, the American Society for Testing Materials, the American Institute of Electrical Engineers, the American Institute of Physics, and the National Research Council.

**Dr. Henry Phelps Gage,** noted authority in the field of optics, and a Fellow and Member Emeritus of I.E.S., died February 9.

Dr. Gage, who first joined the Society in 1911, was elected a Fellow in 1946, in recognition of his contributions on optical projection, on optical properties of colored glass, and in the field of standardization of colored glass for lighthouse and aviation signals. He was active on I.E.S. technical committees and was long the Society's Official Representative to the Inter-Society Color Council.

On his retirement, in 1947, from Corning Glass Works, where he was Chief of the Optical Division, Dr. Gage was elected a Member Emeritus of I.E.S.

## BOOKS AND PAMPHLETS

*Books whose reviews are marked * are available for inspection at the I.E.S. Headquarters office, Technical Dept.*

***The Complete Book of Garden and Outdoor Lighting,** by Bernard Gladstone, published by Hearthside Press, Inc., 118 E. 28th St., New York 16, N. Y. 120 pages, illustrated, $2.95.

This "how to" book is directed at the average householder, to tell and show him when, where and how to use modern equipment in lighting his garden, patio, or other outdoor areas, for living and recreation space and for safety.

Illustrated with line drawings of equipment and installation details, the book also had 30 photographs of garden areas lighted with the techniques mentioned. Chapter titles are:

(1) Planning Your Outdoor Lighting Requirements.
(2) Wiring Your House for Outdoor Living.
(3) Outdoor Lighting Fixtures and Equipment.
(4) Lighting Your Garden.
(5) Lighting the Patio, Terrace and Outdoor Recreation Areas.
(6) Lighting Walks, Driveways and Entrances for Night-time Safety and Convenience.
(7) Building Your Own Outdoor Lighting Equipment and Accessories.
(8) Handling the Insect Problem.
(9) Outdoor Christmas Lighting for Your Home.
(10) Safety Precautions and Maintenance.

The author, a "do-it-yourself man," states that a number of the photographs were taken at his own home.

**Accident Prevention Manual for Industrial Operations,** published by the National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill. 1341 pages, $13.50.

Designed as a basic text for the safety man's shelf, this Third Edition of the Manual contains 43 sections—17 of them new and the others extensively revised and brought up to date.

The book tells how to set up safety committees, maintain interest in accident prevention activities and develop favorable publicity and public relations. There are chapters on accident records and injury rates, accident investigation and costs and workmen's compensation insurance. There is technical information on subjects such as pressure vessels, handling materials, conveyors, machine tools, welding, portable power tools, electrical hazards, flammable liquids and others.

The Manual is the result of over three years of research, writing and revision by Council engineers and other safety specialists from industry, government and other groups.

**Achievement of Lighting Standards for the Grading of Cotton,** by Dorothy Nickerson. Available on request from Cotton Division, Agricultural Marketing Service, United States Department of Agriculture. 29 pages, mimeographed.

This paper was prepared by the author at the invitation of the Marketing Section, Association of Southern Agricultural Workers, for their meeting February 6-8 in Atlanta, Ga. It traces the developments in the use of daylight and artificial light in cotton classification. General principles for color grading of other products are included.

Sections of the paper are: Lighting Important to Cotton Classification; Natural Daylight Studies, 1914-1937; Artificial Daylighting Studies; Development of Fluorescent plus Tungsten Filament Lighting; Development and Improvement of Specifications, 1950-1956; Color of Surrounding Conditions; Maintenance of Lighting Equipment; Spectral Energy Distribution Basic to Color Grading; Summary; Appendix—Specifications for Lighting Units.

(Continued on page 38A)

**Slimline *Lead-lag* ballasts**
**...for lighting economy**

# Know what it costs to send him up a ladder?

Fifty cents a round trip—maybe more. But half his effort may be unnecessary! It's this simple: If you are using series-type ballasts in your lighting fixtures and a lamp burns out, the other lamp burns dimly or goes out completely. The maintenance man has no way of knowing which lamp is defective unless he takes the time to test both. NOT so with Westinghouse slimline *lead-lag* ballasts—when one lamp burns out, the other lamp is not affected. Thus, valuable maintenance time is saved without the possibility of wasting good lamps or losing light. In addition, Westinghouse slimline *lead-lag* ballasts have a new UI core design to give you a cooler, quieter, more efficient operation.

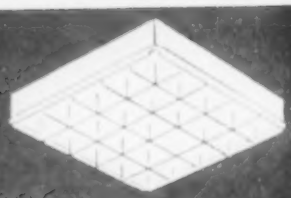
Planning a new lighting system? Specify Westinghouse slimline *lead-lag* ballasts for real lamp replacement economy.

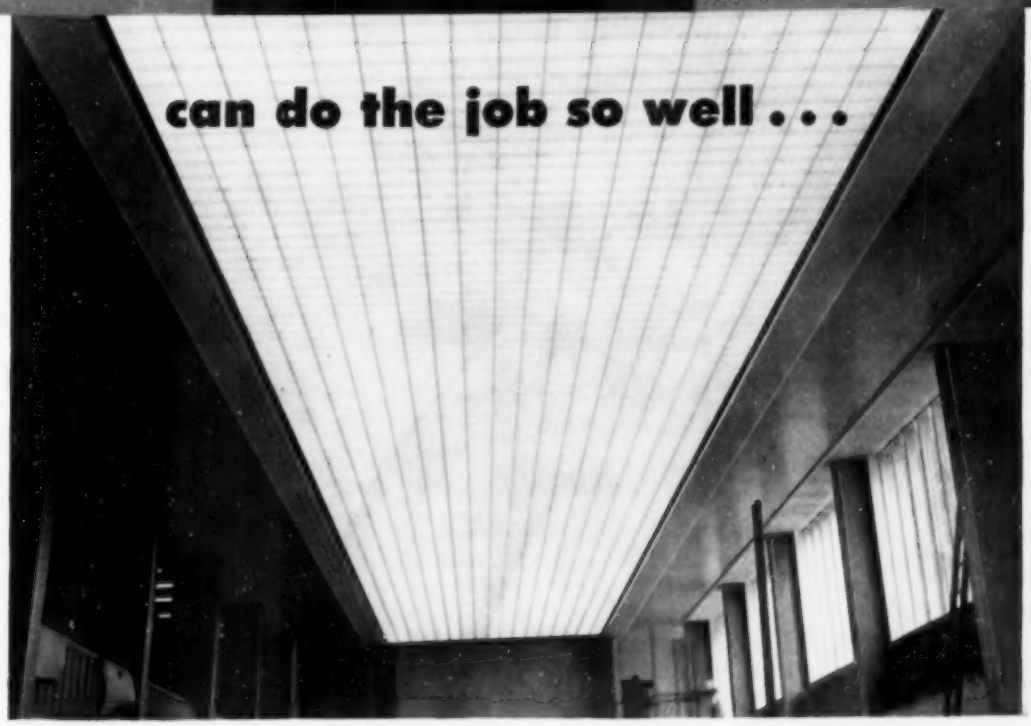
More information? See your Westinghouse representative or write Westinghouse Electric Corporation, Lighting Division, Edgewater Park, Cleveland, Ohio. J-04595

YOU CAN BE SURE...IF IT'S

Westinghouse

# Only - Luve·tile





## can do the job so well . . .

## When it comes to Low brightness, large area light sources . . .

## because . . .

LUVE-TILE in the long run is the most economical illuminated ceiling you can buy.

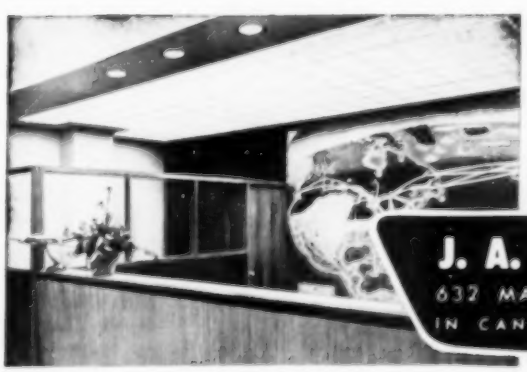
LUVE-TILE is easy to maintain—dirt collection is much less rapid than with other types . . . and it will not hold insects and other small matter.

LUVE-TILE is hinged, servicing of fixtures is easy. Rigid to handle, and light in weight, it is simple to remove and wash.

LUVE-TILE may be assembled to suit any room and custom-made work is never necessary. No unsightly horizontal bars or rosettes are used for support.

LUVE-TILE comes in 4 shades making possible unlimited colour combinations. Sprinklers and air ducts are concealed and wiring and other work may be simply surface mounted. Also low cost acoustic material may be sprayed on the cavity above the tile for sound proofing.

LUVE-TILE is practical and economical to use in any area, right down to a few square feet. It is also widely used in display for special effects.



**J. A. WILSON LIGHTING & DISPLAY INC.**

632 MAIN STREET, BUFFALO 2, N.Y. PHONE MOhawk 3596

IN CANADA: 280 LAKESHORE ROAD, TORONTO, ONTARIO

# Kopp

# FLYING GLASSWARE

## meets *Exacting* specifications

In our own shop, dies and moulds are made, from Kopp engineering designs.

Airport runway lens of extremely complex design being tested for distribution and intensity of illumination.

The utmost dependability under extremely severe service conditions is a requirement of glassware for aircraft applications. Extensive experience in the design and manufacture of specialized glassware has enabled Kopp to develop many special designs that have proved more than a match for the exacting demands of aircraft service.

If you're confronted with a vexing industrial glass problem, let our engineering department help you find the most practical and economical solution.

SUSTAINING MEMBER

KOPP GLASS

## KOPP GLASS, Inc.

Swissvale, Pennsylvania

**BEFORE YOU BUY ANY SCHOOL LIGHTING FIXTURE . . .**

# COMPARE Eastern SCHOOL UNITS

*A style and price to meet every requirement*

**Eastern ENGINEERED "A" SERIES**
**2 lamp — Fluorescent and Slimline**

An "all purpose" unit that combines highest quality and 91% lighting efficiency at a remarkably low price.

**Eastern ENGINEERED "N" SERIES**
**4 lamp — Fluorescent and Slimline**

Features Eastern's exclusive "Zone of Light" — for extra illumination in the study area. Combines smart styling and an efficiency of 77%.

**Eastern ENGINEERED "N44" SERIES**
**2 lamp — Fluorescent and Slimline**

Unquestionably, the finest — companion unit to the 4 lamp "N" Series above. Has an efficiency of 82%.

**Eastern ENGINEERED "N" SERIES**
**2 lamp — Fluorescent and Slimline**

Our most popular school unit — features 90% efficiency

**SEND FOR THIS NEW Eastern CATALOG.**
Contains complete information and technical data. Write for your FREE copy today!

Eastern ENGINEERED

**EASTERN FIXTURE COMPANY**

**170 VERNON STREET, BOSTON 20, MASS.**

*Recessed luminaires for the Royal Castle hamburger stands in the Miami, Florida, area by the Wakefield Company, Vermilion, Ohio. "Lucite" acrylic resin extruded by Southern Plastics Company, Columbia, S. C. Irvin Korach, Donald Smith, A.I.A. Architects, Miami.*

# *Better looking, better lighting*

## with diffusing panels of Du Pont LUCITE®

Everything possible was done to make the recently constructed Royal Castle hamburger stands truly spots "fit for a king." This called for a happy blending of operating efficiency and beauty.

When it came to lighting, the selection was an obvious one . . . the "Castles" get appealing lighting both indoors and out with diffusing panels of extruded "Lucite."

Diffusing panels of "Lucite" acrylic resin transmit optimum light without specular glare or shadow. They are strong, durable, free from discoloration, and dimensionally stable. Installation is a simple matter. Panels of "Lucite" are light in weight and easy to handle . . . maintain their clarity and beauty.

Du Pont "Lucite" can be formed readily into desired shapes and is available in a wide range of transparent and translucent colors.

**Send for free, new booklet.** This new 12-page illustrated booklet describes all the latest property and application data on "Lucite" acrylic resin for lighting. For your free copy, write to E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept., Room 285, Du Pont Building, Wilmington 98, Delaware.

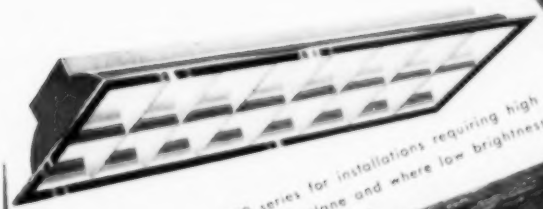
DU PONT

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

*This "Quality Controlled" label may be used only by qualified extruders of Du Pont "Lucite" acrylic resin. It assures the lighting industry that the extruded material conforms to standards for low shrinkage and uniform caliper established by E. I. du Pont de Nemours & Co. (Inc.).*

*Quality Controlled*

# a new visionaire® for maximum visual comfort



Specify Sunbeam's 1920 series for installations requiring high intensity lighting at the work plane and where low brightness at normal viewing angles is important.

Specify Sunbeam's 930 series for areas where maximum light is desired and where lengthwise shielding is not requisite.

**An engineering triumph—** the new 920 series Visionaire® is designed for high intensity, low brightness illumination. Through skillful use of diffuse Alzak double parabolic reflectors, 93.3% of the total illumination output is concentrated within the usable 0° to 60° work zone. Alzak reflectors and louvers not only distribute light more efficiently but sharply decrease glare from normal viewing angles for the ultimate in visual comfort.

**Engineered for installation** and maintenance ease, too. Ample knock-outs; continuous wiring channels; chain-suspended single-unit center "V" and louver assembly and diffuse Alzak with lifetime finish. Enamelled parts Bonderite-treated for maximum protection. Write for bulletin 747.

SUNBEAM visionaire

**SUNBEAM LIGHTING COMPANY**
2727 S. 14th Place, Los Angeles 21, California

Specify

ABOLITE FIXTURES for Schools and Institutions

Glass Steel Diffusers give bright, non-glaring light in **classrooms**. GBF Protecto-Shields with R52 and R57 lamps provide excellent light for **auditoriums** and **gymnasiums**. Deep Bowl Fixtures can be equally effective with 500-1000 watt incandescents. For **corridors** and **shops**, All-White, Slotted-Neck, Standard and Shallow-Dome Fixtures are recommended. For areas **where headroom is at a premium**, Outlet Box Fixtures are the answer. **Athletic fields** and **parking lots** can be superbly lighted with ABOLITE Open Floodlights. Specify Bin Lights for **libraries** and **storage rooms**.

Whatever your lighting requirements, specify ABOLITE.

ABOLITE Lighting DIVISION
THE JONES METAL PRODUCTS CO.
WEST LAFAYETTE, OHIO


(Continued from page 31A)

**Heating, Ventilating, Air Conditioning Guide, 1956,** published by the American Society of Heating and Air Conditioning Engineers, 62 Worth St., New York 13, N. Y. 6" x 9" cloth bound, 1176 pages. $12.

The 34th edition of this guide is now available, described as the result of the efforts and contributions of many engineers and data from all available authoritative sources. Much of the information is the result of work done by the ASHAE Research Laboratory under the direction of the Committee on Research and with the assistance of technical advisory committees. The 53 chapters are grouped under seven sections: I — Fundamentals, II — Human Reactions, III — Heating and Cooling Loads, IV — Combustion and Consumption of Fuels, V — Systems and Equipment, VI — Special Systems, and VII — Instruments and Codes. As in earlier editions, the 24" x 32" ASHAE Psychrometric Chart is included.

**RLM Specifications Book — 1956 Edition,** available from the RLM Standards Institute, 326 W. Madison St., Chicago 6, Ill.

This latest edition contains important revisions in specifications on both incandescent and fluorescent industrial lighting units, according to the announcement, as well as new lighting data of special value to specifiers. Most important of the changes and additions are the new coefficient of utilization tables for eight different incandescent and fluorescent units. Calculations are based on the Zonal Method of computing coefficients of utilization and illumination on room surfaces. Also included are newly revised light distribution curves on RLM Direct and Semi Direct fluorescent lighting units.

**Farm Lighting** — 35mm color filmstrip, available from Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

This film is intended especially for use by colleges, electric power suppliers, agricultural engineers, home economists and vocational instructors, county agents, 4-H Clubs and similar groups. Organizations wishing to have their own copy may purchase one for $10.

The filmstrip consists of 76 frames and is narrated in non-technical language with a standard 33⅓ rpm recording and also a typed manuscript. Running time is 18 minutes. Among the lighting applications illustrated are yard lighting and barn and chicken house lighting. Portable lighting equipment for repair work on farm machinery and applications of infrared heat lamps are illustrated. Use

(Continued on page 40A)


Certified Lighting for a Better America

ELECTRICAL CONTRACTORS, WHOLESALERS, LIGHT & POWER COMPANIES!

This program is sponsored by all these member companies of the Industrial and Commercial Lighting Equipment Section of the National Electrical Manufacturers Association to help you increase your sales.

These manufacturers stand ready collectively and individually to cooperate with you in every possible way to help you get the most out of this CERTIFIED LIGHTING PROGRAM. Call on them!

Abolite Lighting Division
The Jones Metal Products Co.
Amplex Corp.
Art Specialty Co.
Benjamin Electric Mfg. Co.
M. Black Mfg. Co.
Columbia Electric & Mfg. Co.
Compco Corp.
Curtis Lighting, Inc.
Day-Brite Lighting, Inc.
Eastern Fixture Co.
Fluores-O-Lite Co.
The Frink Corp.
Fullerton Mfg. Corp.
Garden City Plating & Mfg. Co.
General Lighting Products Co.
The Edwin F. Guth Co.
Holdenline Co.
Holophane Co., Inc.
The Kirlin Co.
Lighting Products, Inc.
Litecontrol Corp.
Markstone Mfg. Co.
The Miller Co.
Morlite Equipment Co.
Neo-Ray Products, Inc.
Overbagh & Ayres Mfg. Co.
Pittsburgh Reflector Co.
The Pyle National Co.
Quadrangle Mfg. Co.
Ruby-Philite Corp.
Silvray Lighting, Inc.
Smithcraft Lighting Division
A. L. Smith Iron Co.
Smoot-Holman Co.
Solar Light Mfg. Co.
The Spero Electric Corp.
Sun-Lite Mfg. Co.
Sylvania Electric Products, Inc.
Kurt Versen Co.
The Wakefield Co.
Westinghouse Electric Corp.
Wheeler Reflector Co.
R. & W. Wiley, Inc.
The Wiremold Co.

# The 3 Most Important Questions On Your Lighting Prospect's Mind!

How does my present lighting compare with national standards?
What will I gain by new lighting?
How can I be sure that my new lighting will meet the standards?
PLANS WHICH PROVIDE FOR LIGHTING THAT MEETS OR EXCEEDS THESE STANDARDS WILL BE CERTIFIED

## Use the FACT BOOKS for the answers! Then use the CERTIFICATE to clinch the sale!

Sell more and bigger lighting jobs by using the Fact Books of Certified Lighting in your sales approach. They are available to electrical contractors and others wherever the Certified Lighting program is in operation. Use them to show your prospect the national standards and how his present lighting compares with these standards. There is a Fact Book for each type of lighting—for store . . . office . . . school . . . and factory. Use the Fact Books also to show how your plan is certified by an impartial authority and countersigned by you to guarantee that the installation meets national standards. Then . . . use the guarantee certificate itself as the final sales clincher to prove your recommendation is *right in plan—right with standards—right for installation.* Send for free booklet and *free* copies of the four FACT BOOKS today!

### Is Certified Lighting In Operation in Your Area?

This program is operated locally under the joint sponsorship of all electrical groups. If your area is listed below, get in touch with your local group . . . otherwise, write The National Lighting Bureau.

| | |
|---|---|
| Boston, Mass. | Omaha, Neb. |
| Charlotte, N. C. | Providence, R. I. |
| Chattanooga, Tenn. | Rochester, N. Y. |
| Cincinnati, Ohio | Sacramento, Cal. |
| Detroit, Mich. | San Diego, Cal. |
| Los Angeles, Cal. | San Francisco, Cal. |
| New Orleans, La. | Waterbury, Conn. |
| Norwalk, Conn. | Worcester, Mass. |

R-1956

Certified Lighting for a Better America

Copyright 1956, National Lighting Bureau

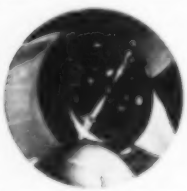
Certified Lighting

NATIONAL LIGHTING BUREAU, 155 East 44th Street, New York City, Sponsored by the Industrial and Commercial Lighting Equipment Section of NEMA the National Electrical Manufacturers Association

**Ask these questions, too, when you judge a fluorescent lamp...**

**Are its electrodes built for longest lamp life?**

Constant development of new and better ways to make fluorescent lamp electrodes has enabled Westinghouse to *triple* the life of its fluorescent lamps since 1948.



**Is it easy to seat securely?**

Westinghouse fluorescent lamps are built with "guide bumps" on the end caps. Easily felt with the fingers during lamp installation, they tell at a touch when the lamp has been securely seated in its sockets.

**Is it the correct type, size and color for the lighting job to be done?**

In the Westinghouse fluorescent family of 290 different lamps—including Slimline and Rapid Start—there's a type and size precisely right for every office, plant and merchandising application. Colors include seven different shades of "white" alone.

For the full story on how to get more for your money in fluorescent light, contact your Westinghouse Lamp Representative. "You can be sure if it's Westinghouse."

***WATCH WESTINGHOUSE***

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU***

(Continued from page 38A)

of incandescent and fluorescent lamps for home and workshop illumination is covered. Production of the film was under the direction of Ervin Baker, rural lighting manager for Sylvania.

## NEW MEMBERS

At the meeting of the I.E.S. Council held at Birmingham, Alabama on April 4, 1956, the following were elected to membership. Names marked * are transfers from Associate Member grade.

ALABAMA SECTION

*Associate Members:*

Babb, J. B., Moore Handley Hardware Co., Inc., Birmingham, Ala.

Hendrickson, D. O., Mack Electric Supply Co., Dothan, Ala.

Nail, J. L., Jr., Van Keuren Davis & Co., Birmingham, Ala.

ARK-LA-TEX CHAPTER

*Associate Member:*

Webster, G. J., Southwestern Gas & Electric Co., Texarkana, Ark.

BLUENOSE CHAPTER

*Member*

Fairn, Laird, Leslie R. Fairn & Associates, Halifax, N. S.

BRITISH COLUMBIA SECTION

*Member:*

*Gordon, D. S., B. C. Electric Co. Ltd., Vancouver, B. C.

*Associate Members:*

Grant, J. W., B. C. Electric Co. Ltd., Abbotsford, B. C.

Lillie, Herbert, James Muirhead Associates, Vancouver, B. C.

CAPITAL SECTION

*Members:*

Cobb, K. W., Kluckhuhn, Cobb & McDavid, Washington, D. C.

Suffsinger, L. R., National Bureau of Standards, Washington, D. C.

CENTRAL ILLINOIS CHAPTER

*Member:*

Young, H. G., Kiefer Electrical Supply Co., Peoria, Ill.

*Associate Member:*

Shaw, C. C., Central Illinois Public Service Co., Paxton, Ill.

CENTRAL NEW YORK SECTION

*Associate Members:*

Kiser, E. L., Niagara Mohawk Power Corp., Rome, N. Y.

Larabee, J. C., General Electric Co., Albany, N. Y.

Lee, J. W., Niagara Mohawk Power Corp., Rome, N. Y.

Madill, G. C., Niagara Mohawk Power Corp., Watertown, N. Y.

Passage, R. W., Graybar Electric Co., Syracuse, N. Y.

Plummer, D. H., LeValley McLeod Inc., Elmira, N. Y.

Schenck, R. J., Hunter & Bell Inc., Buffalo, N. Y.

CENTRAL OKLAHOMA CHAPTER

*Associate Members:*

Kimball, O. A., Westinghouse Electric Supply Co., Oklahoma City, Okla.

Wear, B. L., Wear Electric Co., Oklahoma City, Okla.

CHICAGO SECTION

*Members:*

Haggstrom, R. W., Jefferson Electric Co., Bellwood, Ill.

Zuchnow, W. H., Curtis Lighting, Inc., Chicago, Ill.

*Associate Members:*

Butler, R. T., Westinghouse Electric Corp., Chicago, Ill.

Goodrich, Jack, Lightolier Co., Chicago, Ill.

Grabowski, R. C., Stanley Electric, Chicago, Ill.

Murray, E. L., General Electric Co., Chicago, Ill.

Schwenkler, N. H., Luminator-Harrison Inc., Chicago, Ill.

*Student Member:*

Rajagopaliengar, B. S., University of Illinois, Champaign, Ill.

CLEVELAND SECTION

*Members:*

*Carlson, F. E., General Electric Co., Cleveland, Ohio.

Lahm, A. H., The Wakefield Co., Vermilion, Ohio.

*Schwartz, Allan, The H. Leff Electric Co., Cleveland, Ohio.

*Associate Members:*

Meltzer, W. G., Luminous Ceilings, Inc., Cleveland, Ohio.

Raike, G. W., Church Street at 2nd, Ashland, Ohio.

Walter, T. S., Westinghouse Electric Corp., Cleveland, Ohio.

CORNHUSKER CHAPTER

*Member:*

Wallin, C. L., Henningson, Durham & Richardson, Inc., Omaha, Nebr.

EASTERN PENNSYLVANIA SECTION

*Associate Member:*

Steffy, A. W., Metropolitan Edison Co., Reading, Pa.

FOREIGN NON SECTION

*Members:*

Demostre, Luis F., Demostre & Cia. S. A., Habana, Cuba.

*Grandi, Renzo, Buini & Grandi S. A., Bologna, Italy.

*Associate Members:*

Bearden, A. R., U.S.A.F. Base, Goose Bay, Labrador, N. F.

Ebben, D., Crompton Parkinson Ltd., Guiseley, near Leeds, Yorkshire, England.

Gerdts, Hans, Lt. Commander, Armada Republica de Colombia, Cartegena, Colombia, S. A.

GEORGIA SECTION

*Members:*

McMichael, R. A., Georgia Power Co., Statesboro, Ga.

*Pearson, W. M., Graybar Electric Co., Atlanta, Ga.

*Associate Member:*

Dreyfuss, M. J., Jules J. Dreyfuss' Sons, Atlanta, Ga.

GOLDEN GATE SECTION

*Associate Members:*

Bale, A. J., Jr., Hertzka & Knowles, San Francisco, Calif.

Clendenin, J. S., Hexcel Products Inc., Oakland, Calif.

Donnelly, R. G., McMillen-Stanley Sales Corp., San Francisco, Calif.

Dunsmoor, C. W., F. K. Pinney, Inc., San Francisco, Calif.

Grotts, H. J., Tide Water Associated Oil Co., Associated, Calif.

Gunz, J. S., Pacific Gas & Electric Co., Richmond, Calif.

LaMonte, Frank, Westinghouse Electric Supply Co., San Francisco, Calif.

Montgomery, A. D., Pacific Gas & Electric Co., Santa Rosa, Calif.

HAMILTON-ONTARIO CHAPTER

*Associate Member:*

Maude, C. N., Chadwick Electric Co. Ltd., Hamilton, Ont.

INDIANA SECTION

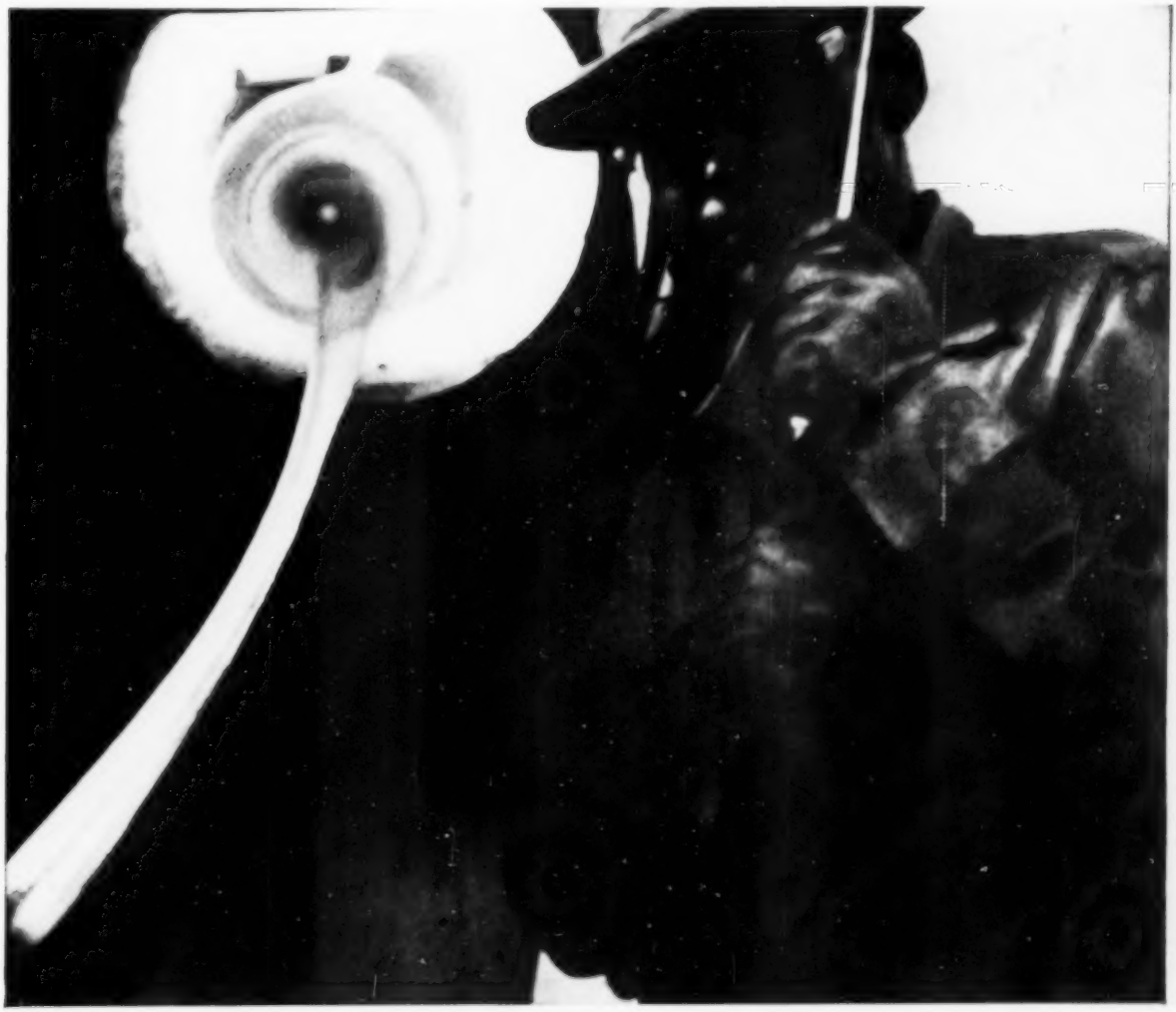
*Associate Members:*

Angrick, P. R., Engineering Products, Indianapolis, Ind.

Connelly, T. J., Jr., General Electric Co., Indianapolis, Ind.

(Continued on page 45A)

how to judge a fluorescent lamp . . . point no. 3

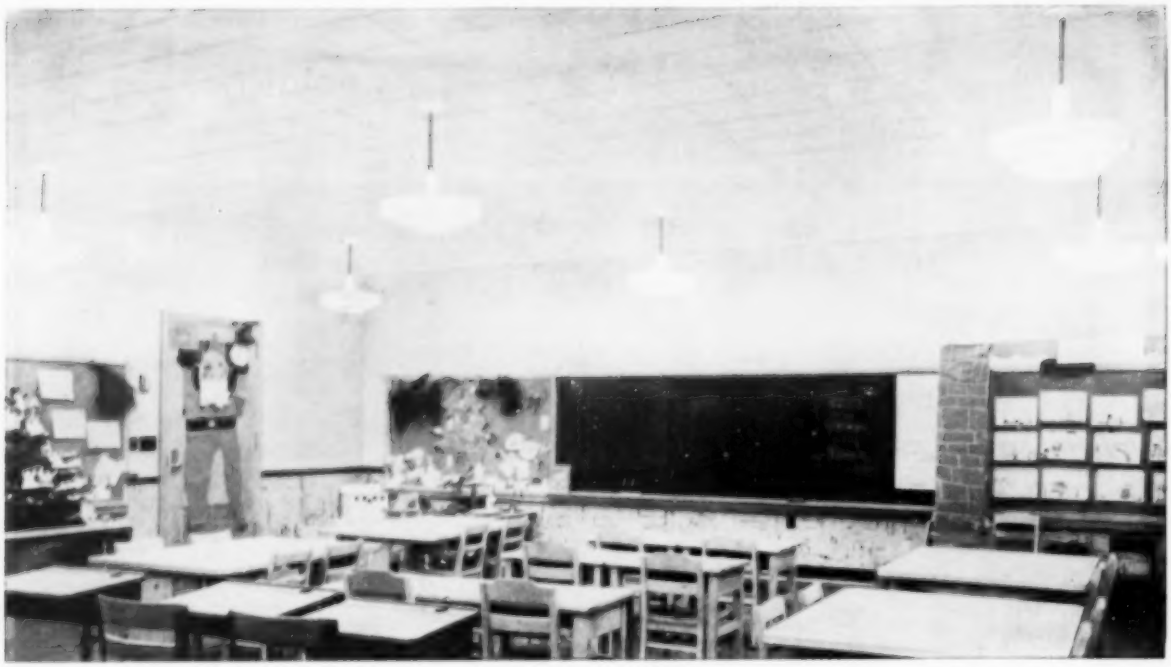


# ask about TAILORED GLASS

Quality of glass in a fluorescent lamp directly affects lamp performance. For example: if the "surface condition" of the glass is not exactly right, the lamp's light-producing phosphor coating will not stick securely to the inside of the tube, and bare spots will develop. To make *sure* of proper surface condition — as well as high strength, good clarity, precise dimensions and other essential properties — Westinghouse makes all of its own fluorescent lamp glass, tailoring it from silica to finished tubing specifically for fluorescent service. "You can be sure if it's Westinghouse."

**WATCH WESTINGHOUSE**

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU***



North Eggert School, Eggertsville, New York • Architect Duane Lyman & Assoc. • Lighting designed by E. S. Burrows

# *A School Problem*...IN LIGHTING*

## To provide recommended levels of good quality illumination in a classroom with LOW CEILINGS

**THE BASIC FACTS** . . . Classroom shown above measures 29' by 27' by 9' 3" high. Surface characteristics are as follows: White ceiling, perforated acoustic tile—80% RF; Green walls, cinder block—55% RF; Natural wood trim—40% RF; Mottled gray, asphalt tile dado—25% RF; Dark green floor, asphalt tile—10% RF†; Black chalkboard—7% RF†; Natural wood desk top—50% RF; Light tan window shades—60% RF.

†*Dark floor and chalkboard not recommendations of American Standard Practice for School Lighting*

***Data as reported in the February 1956 Issue of ILLUMINATING ENGINEERING**

Data submitted by Niagara, Mohawk Power Corp. shows that SILVRAY Concentric Ring Silvered Bowl Units can successfully solve problems of LOW CEILING SCHOOL LIGHTING

**THE SOLUTION** . . . Nine pendent mounted concentric ring luminaires (Silvray Lighting, Inc. Cat. No. 1500S/3R/5) using 500-w PS-40 inside-frosted silvered-bowl lamps were suspended 24" overall, mounted 9' on centers. Average general illumination two months after installation at desk top height measured 52 footcandles.

### BRIGHTNESS RESULTS

| | | | |
|---|---|---|---|
| LUMINAIRE (at 45°) Maximum | 650 ft-L | | |
| CEILING—Maximum | 130 ft-L | Minimum | 26 ft-L |
| FRONT WALL (between rows of luminaires) | 12 ft-L | | |
| (opposite rows of luminaires) | 15 ft-L | | |
| TRIM | 10 ft-L | DADO | 6 ft-L |
| FLOOR | 4 ft-L | CHALKBOARD | 2 ft-L |
| DESK TOP | 25 ft-L | WINDOW SHADES | 15 ft-L |

*For Correct School Lighting its always.*

**SILVRAY LIGHTING, INC.**
AND ASSOCIATED COMPANIES
OFFICE: RKO BLDG., RADIO CITY, NEW YORK

This electrical surge test is one of the 258 tests that every G-E ballast receives during the manufacturing cycle. This test subjects G-E ballasts to the most severe conditions they will ever encounter in actual operation; assuring you of long ballast life and low lighting costs.

***Flora* shows you why . . .***

# Superior Quality Control of G-E Ballasts Helps You Save Lighting Dollars

Lighting engineers, designers, and users have learned to depend upon the consistently high quality of General Electric fluorescent lamp ballasts.

They know that the rigid material specifications and constant production line tests mean uniformly good ballasts; save lighting dollars by minimizing early replacement and maintenance costs.

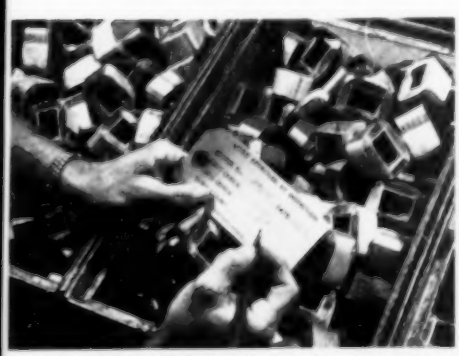
Starting with raw steel and copper wire at the receiving dock and ending only when the finished ballast is loaded for shipment, G-E quality control engineers constantly test raw material and ballast parts to meet rigid mechanical and electrical requirements.

By actual count a G-E ballast receives 258 different tests and checks before packing and shipment! This painstaking care pays off to you in highly dependable operation, efficient lamp output, and long ballast life—it saves you valuable lighting dollars.

Next time you specify equipment for a fluorescent lighting installation, make sure you get the best...specify General Electric quality-controlled ballasts.

A G-E ballast tag or sticker on your fixture is proof that it's equipped with the best in ballast value. It's the easy way to be certain. For further information on G-E ballasts, write Section 401-9, General Electric Company, Schenectady 5, New York.

*Miss Fluorescent Ballast. G-E 's Ballast Mascot
Copyright 1955, General Electric Company



CLOSE INSPECTION of each component assures you of high quality ballasts, lower lighting costs and dependable performance.

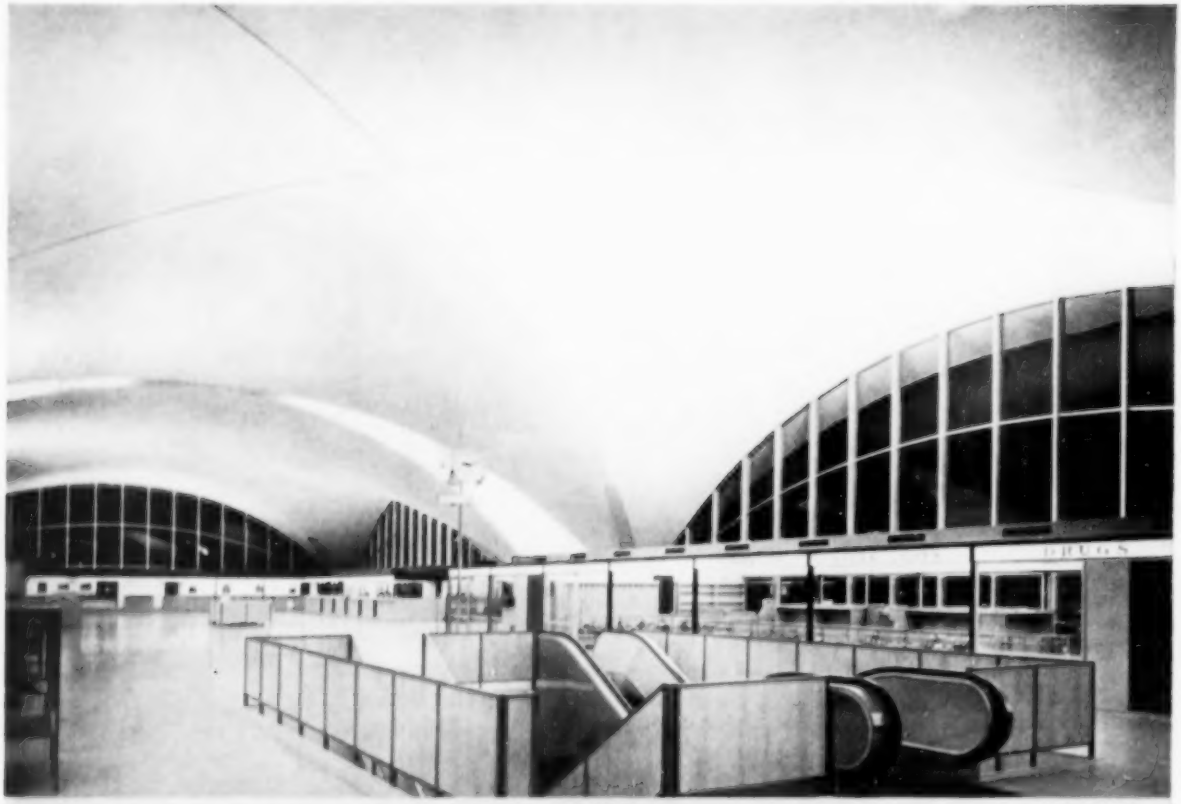
*Five more reasons why*

GENERAL ELECTRIC IS YOUR BEST BALLAST VALUE

- EXCLUSIVE SOUND RATING SYSTEM
- LONGER BALLAST LIFE
- PRECISE LAMP-MATCHED DESIGN
- PROVED PRODUCT LEADERSHIP
- COMPLETE CUSTOMER SERVICES

*Progress Is Our Most Important Product*

GENERAL ELECTRIC



# St. Louis Municipal Airport Terminal Building

•

**Hellmuth, Yamasaki & Leinweber, Architects**
**Ferris & Hamig, Electrical Engineers**
**Roberts & Schaefer, Dome Consultants**

•

• 110KW in color corrected mercury lamps, neatly concealed, produce this masterpiece of comfortable indirect light. Not an installation in America like it!...There are 100 Rambusch Field Representatives. One of them is near you and anxious to serve.

**RAMBUSCH** **DESIGNERS • MANUFACTURERS**
**40 WEST 13th STREET, NEW YORK 11, N. Y.**

**Art Metal Elipticone Lighting**

**dramatically invites sales**

ART METAL ELIPTICONE LIGHTING creates a buying atmosphere in this contemporary super market.

ELIPTICONE versatility offers:

- Unawareness of light source
- Low initial cost and maintenance
- Color-accenting through color lamps
- High-lighting displays and promotions

(Continued from page 40A)

IOWA SECTION

*Associate Member:*

Hemann, F. J., Crescent Electric Supply Co., Burlington, Iowa.

MAINE CHAPTER

*Member:*

*Robinson, G. C., Curtis Lighting of Canada, St. John, N. B.

*Associate Members:*

Hanson, B. B., City of Moncton, City Hall, Moncton, N. B.

Mills, G. W., Electrical Distributors Ltd., Truro, N. S.

MARYLAND SECTION

*Associate Member:*

Kuhn, R. K. Jr., U. S. Army Ordnance Corp., Aberdeen, Md.

MEXICO CHAPTER

*Associate Member:*

Vizcarra, V. A., General Electric S.A. de C.V., San Juan de Letran #37, Mexico, D.F.

MICHIGAN SECTION

*Associate Members:*

Adamo, V. P., V. P. Adamo Agency, Detroit, Mich.

Pines, R. V., Smith, Hinchman & Grylls, Detroit, Mich.

Spencer, H. L., Consumers Power Co., Flint, Mich.

Thomas, R. W., Duro-Test Corp., Detroit, Mich.

*Student Members:*

Antonczak, C. W., Shreve, Walker & Associates, Detroit, Mich.

Capra, L. A., University of Michigan, Ann Arbor, Mich.

MID-SOUTH CHAPTER

*Student Members:*

Davis, Montague, Southern Colleges of Optometry, Memphis, Tenn.

Matheson, T. E., Southern College of Optometry, Memphis, Tenn.

Muller, J. J., Southern College of Optometry, Memphis, Tenn.

MILWAUKEE SECTION

*Associate Members:*

Lang, C. J., Schubert Sorenson & Associates, La Crosse, Wis.

Kook, R. W., Electric Supply Corp., Milwaukee, Wis.

*Student Members:*

Davis, J. L., University of Wisconsin, Madison, Wis.

Motz, W. F., University of Wisconsin, Madison, Wis.

MONTREAL SECTION

*Associate Members:*

Martin R. H., Northern Electric Co., Montreal, Que.

Perry, G. H., Canadian Westinghouse Co. Ltd., Montreal, Que.

Rothstein, Ralph, Rest-Glow Mfg. Co. Ltd., Town of Mt. Royal, Que.

MOTHER LODE CHAPTER

*Associate Member:*

Dean, C. A., Jr., Pacific Gas & Electric Co., Sacramento, Calif.

NEW ENGLAND SECTION

*Members:*

*Ball, W. L., Stone & Webster Engineering Corp., Boston, Mass.

Brown, S. C., Graybar Electric Co. Inc., Springfield, Mass.

French, J. K., Electric Supply & Repair Co. Inc., Pittsfield, Mass.

Katz, Boston, 15 Hubbard St., Ludlow, Mass.

Lam, W. M. C., Lam Workshop Inc., Wakefield, Mass.

*Associate Members:*

Drummond, J. B., General Electric Supply Co., Springfield, Mass.

Gloski, Chester, American Electric Supply Co., Greenfield, Mass.

Goulet, W. A., American Electric Supply Co., Boston, Mass.

Hamel, W. D., Jefferson Electric Co., Boston, Mass.

Haswell T. K. Jr., 141 Birch Grove Drive, Pittsfield, Mass.

Heyman, Harry, Standard Electric Co., Springfield, Mass.

NEW YORK SECTION

*Member:*

Weber, J. R., 29 W. 57th St., New York, N. Y.

*Associate Member:*

Hammond, Ruth E., Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

OHIO VALLEY SECTION

*Member:*

Campbell, R. L., Cincinnati Gas & Electric Co., Cincinnati, Ohio.

*Associate Member:*

Bracke, H. E., H. E. Bracke Co., Covington, Ky.

OIL CAPITAL SECTION

*Associate Member:*

Dollmeyer, C. H., Black & West, Tulsa, Okla.

OREGON SECTION

*Members:*

Collins, S. A., Pacific Power & Light Co., Albany, Ore.

*Cottingham, J. T., Portland General Electric Co., Portland, Ore.

*Associate Members:*

Kaufman, E. G., Pacific Power & Light Co., Portland, Ore.

Micho, F. J., General Electric Co., Portland, Ore.

Olson, C. T., Olson Electric Co., Vancouver, Wash.

Statham, Jr. C., Pacific Power & Light Co., Coos Bay, Ore.

(Continued on page 46A)

L & P Precision Tooling Pays Off — FOR YOU!
Here's a multiple die that permits L & P craftsmen to punch out a complete fluorescent unit—up to eight feet long!—in a single operation. The result, faster manufacture, and an impressive saving in time and labor which is promptly passed on to you. Such precision tooling helps explain why there's a guarantee of efficiency, dependability and economy built right into every Light and Power fluorescent fixture.
WRITE TODAY FOR CATALOG AND PRICES
Distributed by Wholesale Dealers Only
L & P
LIGHT & POWER UTILITIES CORP.
1035 Firestone Blvd. Memphis, Tenn.
LIGHT & POWER UTILITIES CORP.

PALMETTO CHAPTER

*Member:*
Franklin, F. G., Lyles, Bissett, Carlisle & Wolff, Columbia, S. C.

*Associate Member:*
Armour, T. S., Jr., Lyles, Bissett, Carlisle & Wolff, Columbia, S. C.

PHILADELPHIA SECTION

*Associate Member:*
Cook, J. E., Independent Wiring Co. Inc., Philadelphia, Pa.

PITTSBURGH SECTION

*Member:*
Feige, H. C. O., Sylvania Electric Products Inc., Wheeling, W. Va.

*Associate Members:*
Goodman, C. L., Pennsylvania Power Co., New Castle, Pa.
Kendall, A. C., Sylvania Electric Products Inc., Wheeling, W. Va.
Latterman, B. B., Northern Light Co., Pittsburgh, Pa.
Simon, William, Simon Electric Co., Pittsburgh, Pa.
Wettlaufer, G. L., La Salle Electric Supply Co., Pittsburgh, Pa.

*Student Member:*
Luxenberg, M. B., University of Pittsburgh, Pittsburgh, Pa.

PUGET SOUND SECTION

*Associate Member:*
Jarvie, R. M., 1041 W. 167th St., Seattle, Wash.

ROCKY MOUNTAIN SECTION

*Associate Member:*
Larson, C. A., Jefferson County Public Schools, Lakewood, Colo.

ST. LOUIS SECTION

*Associate Members:*
Dittmeyer, R. J., St. Louis Board of Education, St. Louis, Mo.
Muckler, R. M., St. Louis Board of Education, St. Louis, Mo.
Raab, N. L., Union Electric Co. St. Louis, Mo.

SAN JACINTO SECTION

*Associate Member:*
Witt, R. O., Peabody Brothers, Houston, Texas.

SOUTHEAST FLORIDA CHAPTER

*Student Members:*
Quimby, T. W., University of Miami, Coral Gables, Fla.
Sanfield, S. H., University of Miami, Coral Gables, Fla.
Sova, Stanley, University of Miami, Coral Gables, Fla.
Yulken, B. S., University of Miami, Coral Gables, Fla.

SOUTHERN CALIFORNIA SECTION

*Member:*
Cole, R. W., C. W. Cole & Co. Inc., Los Angeles, Calif.

*Associate Members:*
Bonner, A. V., Southern California Edison Co., San Fernando, Calif.
Brinton, H. R., Marvin Mfg. Co., Los Angeles, Calif.
Chesebrough, P. G., Southern California Edison Co., Oxnard, Calif.
Conn, C. C., Jr., Southern California Edison Co., Santa Ana, Calif.
Crum, G. A., Southern California Edison Co., Vernon, Los Angeles, Calif.
Florin, J. G., Southern California Edison Co., Long Beach, Calif.
Foster, J. R., Jr., Southern California Edison Co., Redondo Beach, Calif.
Greenberg, M. B., The Lightrend Co. Inc., Los Angeles, Calif.
Haley, K. B., Southern California Edison Co., Alhambra, Calif.
Jacobs, A. F., Lumidor Co., Vernon, Calif.
Larimore, R. D., Southern California Edison Co., Inglewood, Calif.
Lee, L. L., Southern California Edison Co., Redondo Beach, Calif.
Milner, L. F., The Lightrend Co. Inc., Los Angeles, Calif.
Northrop, J. A., Southern California Edison Co., Huntington Park, Calif.

Overmyer, J. C., Southern California Edison Co., Long Beach, Calif.
Pepper, C. M., Southern California Edison Co., Redlands, Calif.
Perry, A. R., Southern California Edison Co., Whittier, Calif.
Rawlinson, Donald, Southern California Edison Co., Santa Monica, Calif.
Shittler, J. H., Southern California Edison Co., Inglewood, Calif.
Stauter, R. H., Southern California Edison Co., Santa Monica, Calif.
Waddell, R. H., Sylvania Electric Products Inc., Los Angeles, Calif.
Wellman, E. R., Globe Lighting Products Inc., Los Angeles, Calif.

SOUTHWESTERN SECTION

*Associate Member*:
Morton, J. E., Wright Light Inc., Ft. Worth, Texas.
Owen, C. E., Texas Electric Service Co., Wichita Falls, Texas.

TAR HEEL SECTION

*Associate Members*:
Hoyt, J. G., General Electric Co., Hendersonville, N. C.
Moore, R. L., Jr., Duke Power Co., Charlotte, N. C.

TENNESSEE VALLEY SECTION

*Associate Member*:
Ensor, W. S., Tafel Electric & Supply Co., Nashville, Tenn.

TORONTO SECTION

*Associate Members*:
Brook, G. F., M. M. Dillon & Co. Ltd., London, Ont.
Donahue, H. B., Canadian Westinghouse Supply Co. Ltd., London, Ont.
Johnstone, Stanley, Canadian Westinghouse Supply Co. Ltd., Toronto, Ont.
Smith, W. S., Canadian Line Materials, Toronto, Ont.
Suttcliffe, Norman, Columbia Electric Ltd., Toronto, Ont.

TWIN CITY SECTION

*Associate Member*:
Myhr, L. P., Moe Light (Thomas Industries), Minneapolis, Minn.

WESTERN MICHIGAN SECTION

*Associate Member*:
Marshall, Leo, Fitzpatrick Electric Supply Co., Muskegon, Mich.

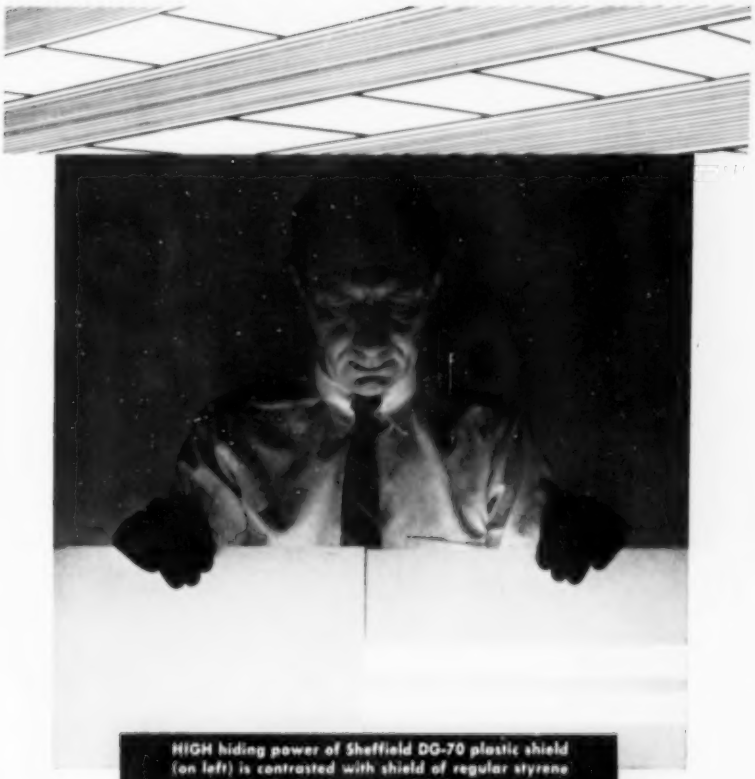
WESTERN NEW YORK SECTION

*Associate Members*:
Abbott, F. R., Graybar Electric Co., Buffalo, N. Y.
Harrington, J. J., New York State Electric & Gas, Lockport, N. Y.
Hill, R. B., Gilar Ban Corp., Buffalo, N. Y.
Kirby, K. C., New York State Electric & Gas Corp., Lancaster, N. Y.
Schweizer, G. E., Backus, Crane & Love, Buffalo, N. Y.
Wholahan, A. D., St. John, Platt & Carlton, Buffalo, N. Y.
Wilkinson, H. E., Jr., Graybar Electric Co., Inc., Buffalo, N. Y.

WESTERN CANADA CHAPTER

*Member*
Tate, W. H., Canadian General Electric Co., Calgary, Alta.
*Associate Members*
Anderson, R. A., Mutual Electric Co. Ltd., Edmonton, Alta.
Ashley, Leslie, Canadian General Electric Co., Calgary, Alta.
Bezer, J. M., Eric Ackland & Associates Ltd., Calgary, Alta.
Carmichael, W. R. L., Industrial Power Installations Ltd., Edmonton, Alta.
Connaughton, J. M., Johnson Bros. Electric Co., Ltd., Edmonton, Alta.
Curfman, C. R., J. H. Ashdown Hardware Co. Ltd., Edmonton, Alta.
Forbes, G. F., Northern Electric Co., Ltd., Regina, Sask.
Gut, W. P., Wilf Gut Electric, Edmonton, Alta.
Jones, T. E., Angus, Butler & Associates, Calgary, Alta.

(Continued on page 48A)

**HIGH hiding power of Sheffield DG-70 plastic shield (on left) is contrasted with shield of regular styrene (on right). Shields have equal light transmission.**

# NEW SHEFFIELD SHIELDS IMPROVE LIGHTING EFFICIENCY AND APPEARANCE OF FLUORESCENT FIXTURES

Sheffield's new DG-70 polystyrene shields have higher hiding power and higher light transmission (up to 50%) than regular styrene shields. The lighting efficiency of plastic-shielded troffer units can thus be increased without sacrifice of their soft, even, glare-free, lighting qualities.

DG-70 shields not only make possible higher efficiency ratings, for present fixtures — without expensive design changes — but, because of the possible variations in light transmission and hiding power, create opportunities for entirely new designs. They are another example of Sheffield engineering leadership in the design and manufacture of rigid plastic extrusions.

If you have not investigated Sheffield DG-70 shields or are in need of a rigid plastic extrusion, call or write, Sheffield Plastics Inc., Dept. 61-3B, Sheffield, Mass.

*Precision Engineered Rigid Plastic Extrusions*

SHEFFIELD PLASTICS
INC.
SHEFFIELD, MASS.

# design by mcPhilben

VAPOR-TIGHT
WALL MOUNTED
43-40VT
43-44 VT (guarded)

Representatives in major cities
Stocked by Electrical Wholesalers

**Utility – good looks – rugged,** maintenance-free McPhilben quality! Who else but McPhilben packs so much in so versatile a line of lighting fixtures? Who else but McPhilben offers the smart simplicity of years-ahead styling, the inherent permanence of anodized cast aluminum construction . . . the fine attention to engineering detail, the range of applications . . . the superiority of performance?

**If you've a lighting problem** . . . for hotels, schools, hospitals, industry, housing, prisons, public or office buildings . . . write us today. Our field-trained representative will be glad to discuss your needs and applications. Consult, and specify McPhilben . . . pioneer and pacemaker in cast aluminum fixtures and institutional lighting for over 41 years.

CONSULT
mcPhilben Lighting
SPECIFY

1329 Willoughby Avenue, Brooklyn 37, N. Y.

VAPOR-TIGHT
CEILING MOUNTED
43-45VT
45-46 VT (guarded)


## NEW OFFICE LIGHTING PRACTICE MEETS INDUSTRY NEED

In the June issue of ILLUMINATING ENGINEERING will be published the first "I.E.S. Recommended Practice for Office Lighting" since 1947. If you are involved in this phase of the lighting industry, you know the size of the market, both in relighting and lighting for new office construction. You also know of the tremendous advances which have been made in office lighting in those past nine years, so we can't tell you how important the new "I.E.S. Recommended Practice for Office Lighting" is to the lighting industry and to you.

***However, the new office lighting practice will be vastly important to others . . . who may not see ILLUMINATING ENGINEERING***

*Construction company engineers*
*Building managers and engineers*
*Realty companies*
*Some consulting engineers*
*Many architects*
*Hundreds of others responsible for office lighting and improvement*

***Primarily through members of the lighting industry will these others learn of this significant new thinking as shown in the new "I.E.S. Recommended Practice for Office Lighting."***

This brand-new lighting practice will be available in booklet form soon after it appears in ILLUMINATING ENGINEERING. In it will be found the latest findings of an I.E.S. Technical Committee which worked for nine years to develop the information in its most usable form. The new practice is approved by I.E.S. Council and is backed by full Society approval. It covers the whole broad field of office lighting . . . fixtures, type and placement; types of lamps; levels of illumination; wall and ceiling colors and reflectances; window placement and use of daylight; provides information on hundreds of office lighting problems.

Use individual copies of the new "I.E.S. Recommended Practice for Office Lighting" to back up your lighting recommendations. Copies may be obtained from Publications Office, I.E.S. headquarters. Special prices for quantities.

**Illuminating Engineering Society**

*1860 Broadway*
*New York 23, N. Y.*

(Continued from page 47A)

Lees, Floyd, Manufacturers Western Representatives Ltd., Edmonton, Alta.
MacDonald, H. D., Canadian Westinghouse Supply Co. Ltd., Calgary, Alta.
Machtmes, C., Canadian Westinghouse Supply Co., Calgary, Alta.
Mackie, A. G., Canadian General Electric Co., Calgary, Alta.
Marrin, L. E., Crowther, Mackay & Assoc. Ltd., Edmonton, Alta.
McKenzie, G. W., Calgary Power Ltd., Calgary, Alta.
McNeil, R. F., Bruce Robinson Electric (Edm.) Ltd., Edmonton, Alta.
Michie, C. G., Crowther, MacKey & Associates Ltd., Edmonton, Alta.
Oliver, W. R., Canadian Westinghouse Supply Co., Ltd., Calgary, Alta.
Parker, Ron, Parker Electric, Calgary, Alta.
Peterson, D. A., Northland Utilities Ltd., Edmonton, Alta.
Price, T. D., Progress Electric Ltd., Edmonton, Alta.
Saunders, G. J., Wirtanen Electric Co. Ltd., Edmonton, Alta.
Shannon, D. A., F. D. Bolton Ltd., Edmonton, Alta.
Shortreed, R., Simpson Allsopp & Assoc. Ltd., Calgary, Alta.
Sims, G. E., Colin Allan Ltd. Edmonton, Alta.
Stephen, J. D., Garry Co. of Canada Ltd., Winnipeg, Man.
Tucker, D. A., Canadian Comstock Co., Edmonton, Alta.
Vickers, Martin, Angus Butler & Associates, Calgary, Alta.
Wardrop, W. L., W. L. Wardrop & Associates, Winnipeg, Man.

## Employment Opportunities

### ASSISTANT DESIGNER WANTED

By nationally-known residential fixture manufacturer. Must have mechanical ability to aid in development of new samples. Practical shop experience will be provided. Company benefits. Unusual opportunity. Age 25 to 35. State complete background and salary desired. All replies held in confidence. Address Box 269, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N.Y.

### TWO LIGHTING SALES REPRESENTATIVES WANTED

1—Minnesota, Western Wisconsin, North and South Dakota Territories.

2—Florida Territories.

Seek two experienced commission salesmen with ambition, drive, and yen to make more money. Should be well-versed in all phases of the lighting field. Engineering or technical background helpful. Must be calling on architects, engineers, distributors and contractors. Our men get powerful promotional backing. These openings are due to a long-range expansion of our facilities, lines and promotional programs. Send full details to: Box 273, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

### LIGHTING ENGINEERS

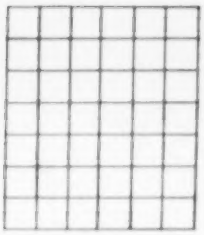
Large nationally known Chicago manufacturer has openings for two young lighting engineers under 35 years of age. One position requires knowledge and training in the fundamentals and the application of light to outdoor lighting. The other requires knowledge and experience in the use of light testing equipment and procedure. Our company has a pension plan and offers free group insurance including life, sickness, accident, and hospital benefits. Please give complete information and qualifications with your reply. All information held in strict confidence. Address Box 274, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

### SALES ENGINEER

We offer an excellent opportunity to a sales engineer showing initiative and good judgment. Graduate with sales experience and engineering background preferred. Company offers training period for field work in highly productive Midwest territory. Salary commensurate with experience, liberal commission. Write stating education, experience, salary requirements and availability to:

Holophane Company, Inc.
Dept. N, 342 Madison Avenue
New York 17, N. Y.


ONE FIXTURE:

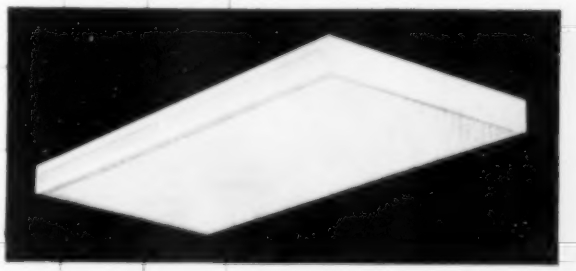


8 sq. feet

of

unobstructed

illumination



NEW

electro silv-a-king

surf-a-lite

Our new Surf-A-Lite achieves a uniform luminosity over its entire 2 ft. x 4 ft. surface—free of visible metal bands and dark islands. The entire fixture presents a smooth appearance with no visible screws or latches when the "Magic Frame" door is closed.

Through the use of various diffusing media the desired comfort ratio can be obtained for any installation. And when used with our exclusive ½" sq. "Poly Cube" polystyrene louver it achieves a glowing, jewel like appearance which you will find adds to the beauty of the most luxurious interior.

**SHALLOW 3½" FIXTURE mounts flush to ceiling . . . modular design for unlimited variety of lighting patterns.**

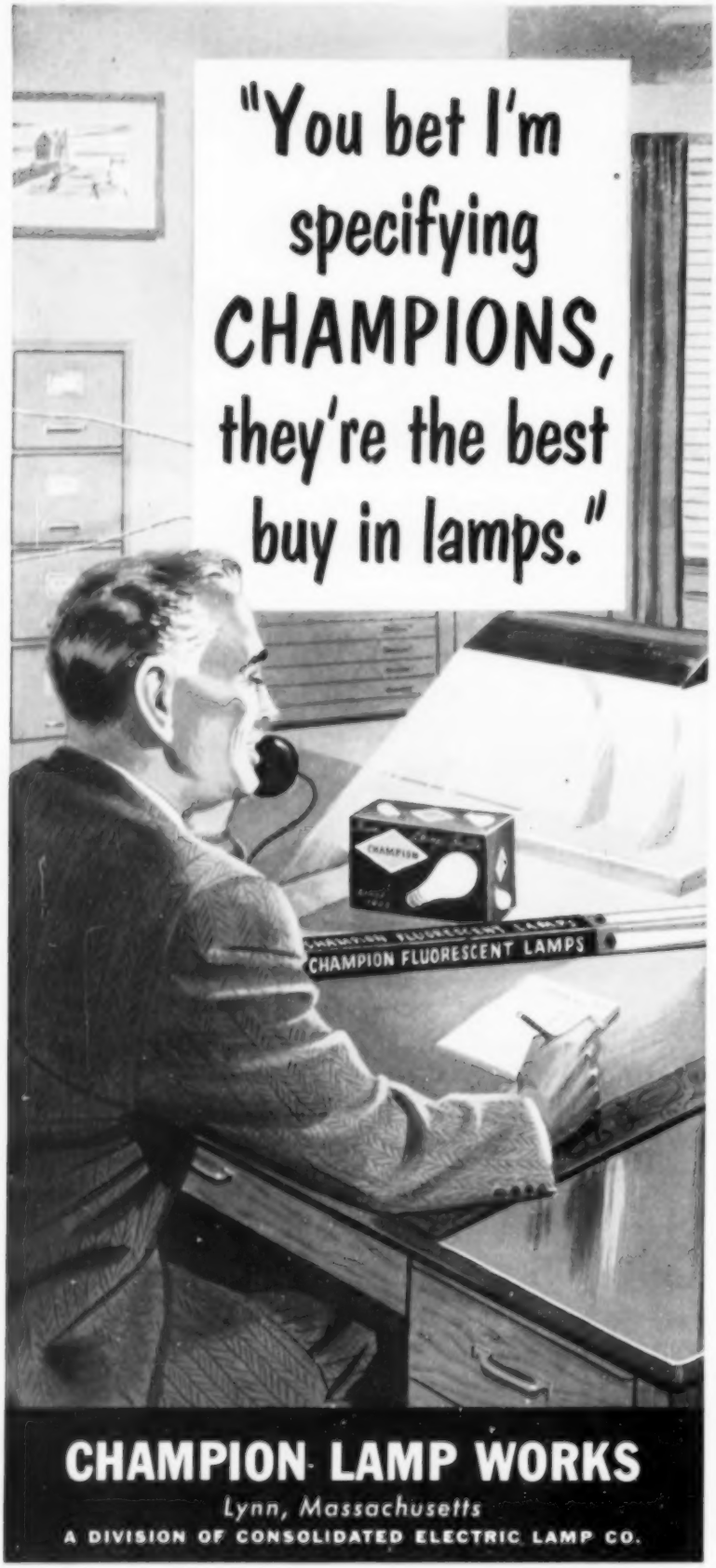
Available in two and four lamp units, 12", 17", or 24" wide—4 ft. or 8 ft. long . . . in ½" sq. "Poly-Cube" polystyrene louver, pattern #70 low brightness lens panel or Alba Glass diffusers with metal or plastic sides.

Complete specification and installation data available upon request.

electro silv-a-king corporation

1535 S. Paulina Street, Chicago 8, Ill.
Spruce and Water Sts., Reading, Pa.

DESIGNERS AND MANUFACTURERS OF THE FINEST IN LIGHTING




**CHAMPION LAMP WORKS**

*Lynn, Massachusetts*

**A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO.**

**Now!**

**NO VISIBLE TRIM**
**in kurt versen's**
**NEW Reflex!**

**This newest fixture simplifies the problem of maintaining an unbroken ceiling line.**

- *no visible trim on ceiling* — a perfectly smooth ceiling, without special plastering or handling.
- *practically invisible light source* — dramatic lighting effects, at maximum efficiency.
- *baffled down-light* or adjustable beam models available for widest applications.
- *top or bottom servicing* — standard on all units, with maximum ease of replacing lamps.
- *all electrical work at one time* — cuts installation costs in half, because of kurt versen cost-reducing detachable yoke construction and no-frame* installation.

**For the latest improvements in lighting design, always refer to kurt versen fixtures... they look better, work better, last longer.**

**kurt versen company**

englewood, new jersey 25

*contemporary lighting creatively engineered*

*U.S. Patent 2,456,903, 2,614,785, other pats. pend.

DISTINCTIVE

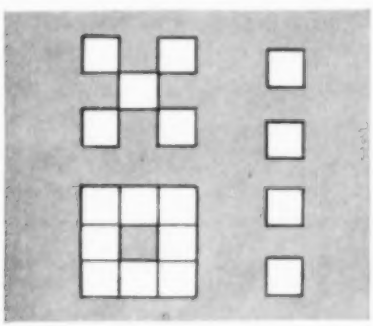
VERSATILE

# ALKCO

## 2300's-2400's

2'x2' BENT GLASS DIFFUSER

- Recessed or Surface Mounted
- Incandescent or Fluorescent
- Extra Large for Glare-Free Light
- Extra Shallow—Fits into Limited Headroom
- Distinctive 24" Square Size Allows Hundreds of Ceiling Arrangements



These low-brightness fixtures are being used in schools, fine offices and stores. You can plan a beautiful ceiling arrangement with these incandescent or fluorescent 2'x2' glass panel fixtures. They blend with any architectural design.

*Send for Descriptive Folder*

**ALKCO MFG. CO.**

A wide variety of stock incandescent and fluorescent fixtures — recessed or surface mounted — plus highest quality custom work too!

**4242 N. Lincoln Ave. • Chicago 18, Ill.**



*50" x 14' sheet extruded for SPANGLER SIGN WORKS, Philadelphia*

GERLITE

*EXTRUDED*

*Acrylic Sheet*

*is* Big Business *at* GERING

This Gerlite sheet, the largest acrylic sheet ever extruded, measures 50" wide by 14 feet long and will be fabricated by Spangler Sign Works for a major oil company.

This is but another example of Gering's ability to extrude Gerlite acrylic sheets to meet every desired requirement in lighting and sign applications.

Sheets are available clear or colored, to 54" wide to .125" thick, any practical length.

Gerlite gives long service, is weather resistant and can be painted or silk-screened with present existing paints.

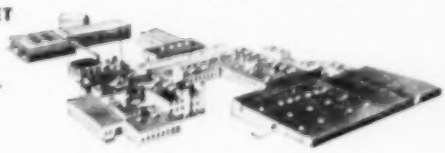
GERLITE

*Quality Controlled*

**EXTRUDED ACRYLIC SHEET**

*Write now for full information and prices!*

**GERING** PRODUCTS, INC.
KENILWORTH, N. J.



# Another First... by PERFECLITE

## A NEW HINGED DESIGN* IN CEILING PAN LIGHTING FIXTURES

No other ceiling pan fixture on the market today offers all these advantages:

- Globe *hinged* for easy cleaning and relamping.
- Unique *safety locking fitter* holds globe in place. No screws, unsightly extensions or trick springs.
- Steel protector ring guards globe against *breakage*.
- Provides *ceiling illumination* as well as evenly distributed floor lighting.

Fixtures are Underwriters Laboratories, Inc. approved. *Patent pending.

AVAILABLE IN THE FOLLOWING SIZES:

| Model | Glass Diameter | Wattage |
|---|---|---|
| HH-9 | 8" | 2- 40 W |
| HH-11 | 10" | 1-100 W |
| HH-13 | 12" | 2- 75 W |
| HH-15 | 14" | 2-100 W |
| HH-17 | 16" | 3-100 W |

PERFECLITE PRODUCTS — THE MARK OF LIGHTING LEADERSHIP

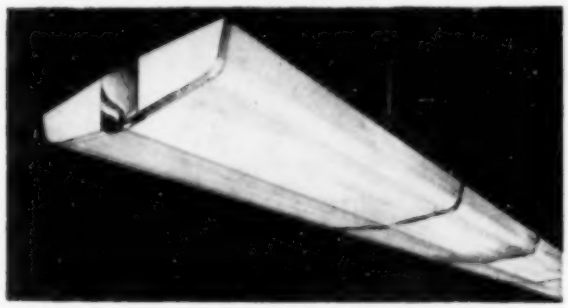
THE PERFECLITE COMPANY
1457 East 40th Street, Cleveland 3, Ohio

Please send me the Perfeclite Data Sheet 56-A for complete information.

Name .....
Address .....
City ..... State .....



# MILWAUKEE ALBA HI-LITE



## Surface Lighting With Beauty in Design

Alba Hi-Lite offers 10 distinctive, clean-cut styles. Perfect for executive offices, board rooms, banks, specialty shops, private clubs, restaurants, institutions, etc. . . . wherever beauty as well as good lighting are desired.

Bent, ribbed Alba-Lite panels for *beauty of simplicity* . . . for *life and punch*. Provide *comfortable* surface brightness with above-average lumens per watt.

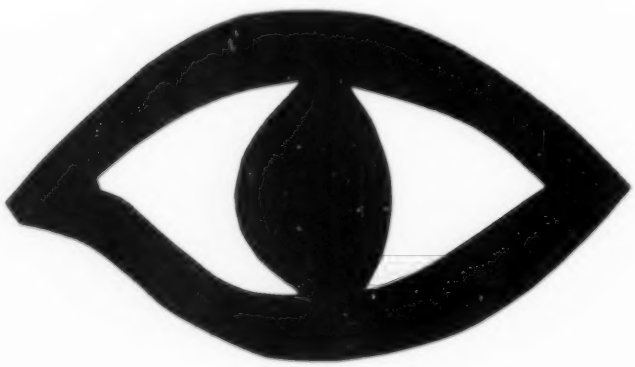
Fixtures are one-piece die-formed 20-gauge cold rolled steel channel, finished in baked white enamel. Uncluttered by frameworks. Require only half the usual stems. Use *surface* or *pendant*, *alone* or in *lines*, 2 or 4 lamp, 2, 4, 6, or 8 ft. lengths for any lamp or ballast. *Easy* to lay out . . . *easy* to hang . . . *easy* to maintain.

**Write for bulletin 121, or see your electrical wholesaler**

**NORTHERN LIGHT COMPANY**
MILWAUKEE
**1661 N. WATER ST.**



*Before recognition, before thinking,*
*before memory, is the eye itself—*
*with its own needs, preferences,*
*limitations . . . We value these first*
*in the design of a lighting instrument*



**Century Lighting, Inc.**
521 West 43rd Street
New York 36, N.Y.

1820-40 Berkeley Street
Santa Monica, Calif.

## INDEX TO ADVERTISERS
May 1956


| | |
|---|---|
| Absolite Lighting Division Jones Metal Products | 38A |
| Advance Transformer Co. | 13A |
| Alkco Manufacturing Co. | 51A |
| Art Metal Co. | 45A |
| Benjamin Electric Mfg. Co. | Inside Front Cover |
| Century Lighting, Inc. | 52A |
| Certified Ballast Manufacturers | Inside Back Cover |
| Champion Lamp Works | 50A |
| Corning Glass Works | 4A |
| Curtis Lighting Inc. | 5A |
| Day-Brite Lighting Inc. | 1A |
| E. I. duPont de Nemours & Co. Inc. | 36A |
| Eastern Fixture Co. | 35A |
| Electro Silv-A-King Corp. | 49A |
| Garden City Plating & Mfg. Co. | 29A |
| General Electric Co., Apparatus | 43A |
| Gering Products Inc. | 51A |
| Gibson Manufacturing Co. | 30A |
| Edwin F. Guth Co. | Back Cover |
| Holophane Company, Inc. | 14A |
| Kopp Glass Inc. | 34A |
| Light & Power Utilities Corp. | 46A |
| Lighting Products Inc. | 25A |
| Litecontrol Corp. | 6A |
| McPhilben Manufacturing Co. | 48A |
| National Lighting Bureau | 38A, 39A |
| Northern Light Co. | 52A |
| Novelty Lighting Corp. | 53A |
| Perfectlite Company | 52A |
| Rambusch Decorating Co. | 44A |
| Rohm & Haas Co. | 19A |
| Sheffield Plastics Inc. | 47A |
| Silvray Lighting Inc. | 42A |
| Smithcraft Lighting Division | 26A |
| Sola Electric Co. | 54A |
| Starring & Company Inc. | 2A |
| Sunbeam Lighting Co. | 37A |
| Sylvania Electric Products Inc. | 17A |
| Kurt Versen Company | 50A |
| Westinghouse Electric Corp., Lamps | 40A, 41A |
| Westinghouse Electric Corp., Lighting | 32A |
| J. A. Wilson Lighting & Display Inc. | 33A |

Introducing NEW

DIRECT-THE-LITE

ADJUSTABLE

Floodlight Reflectors

. . . designed for specific area floodlighting and controlled general illumination. New DIRECT-THE-LITE units by Novelty are recommended for churches, public buildings or commercial application wherever higher intensities are required. Spot lamps or floodlamps may be used, and they are adjustable both horizontally and vertically, approximately 35°. Write for new illustrated folder.

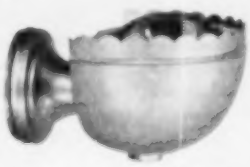
NO. CH 215

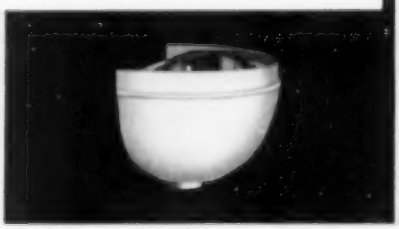
*New Lighting Ideas for*

- Restaurants
- Lounge Bars
- Stage Lighting and TV
- Theaters
- Churches (Chancel)
- Arcades
- Display Windows
- Store Fronts

APPROVED BY UNDERWRITERS' LABORATORIES, INC.

NO. 8264
Furnished in prime coat for painting to match wall or sprayed finish. (Available with two, three or four lamps.)





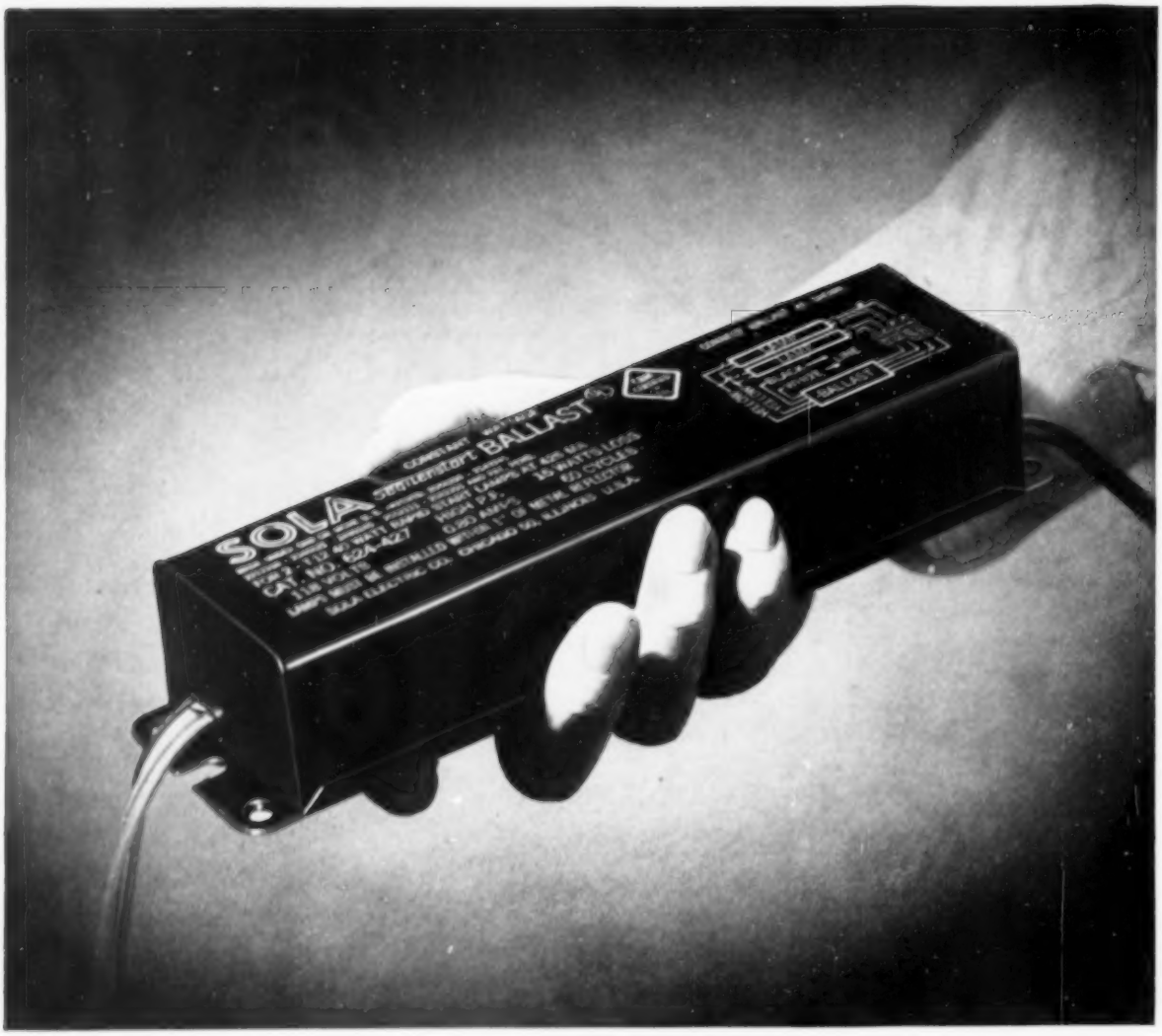
NO. 8251
Alumac finish. Canopy mounting.

NO. 8260
Furnished in prime coat for painting. Keyhole slots and center lockup.

*Designers and Manufacturers . . . Since 1905*

THE NOVELTY LIGHTING CORP.

2490 EAST 22nd STREET CLEVELAND 15, OHIO




# New Sola rapid-start ballast is small, quiet, and cool

Typical of the quality of the complete line of Sola Fluorescent Ballasts is a new two-lamp design for 40WT12 rapid-start lamps. This new ballast (Cat. No. 624-427) provides small size *plus* new standards of coolness and quietness for its specific duty.

**COOL OPERATION:** ETL tests show copper heat rise is only 50.9° C. Low temperature rise results in exceptionally cool operation for ballasts of this type and size.

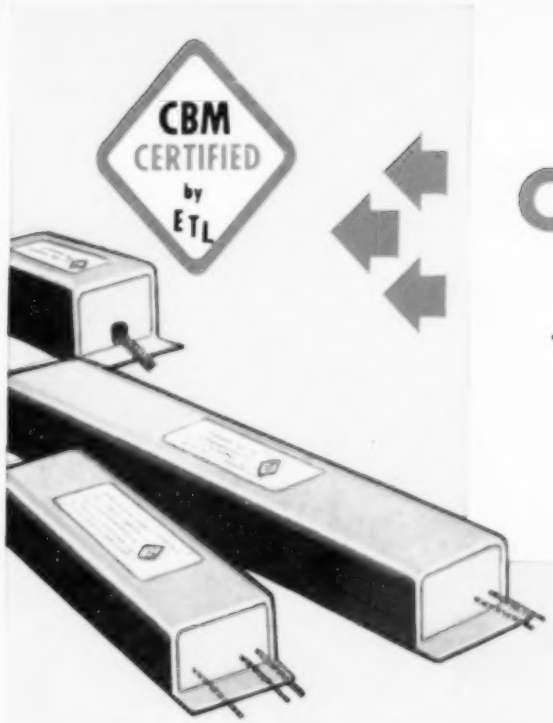
**QUIET OPERATION:** Exclusive Sola methods for core-and-coil assembly, case design, and compounding produce operational quietness exceeding that of other leading ballasts designed for similar duty.

Your area representative, listed below, will be happy to provide further information for you. He's one of a nationwide sales organization maintained by Sola Electric Co. to provide you with prompt service.

**SOLA** *Fluorescent* **BALLASTS**

CBM CERTIFIED by ETL

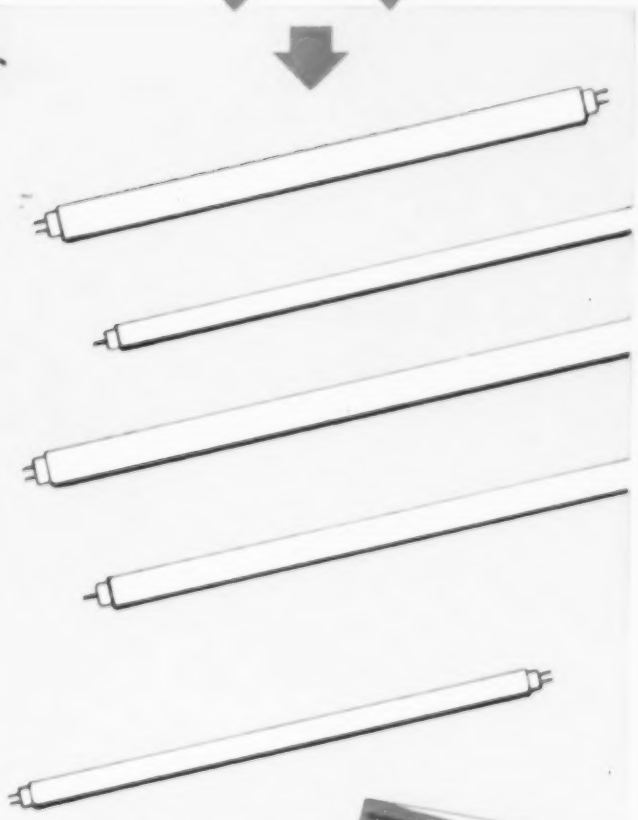
**CONSTANT VOLTAGE TRANSFORMERS** for Regulation of Electronic and Electrical Equipment • **LIGHTING TRANSFORMERS** for All Types of Fluorescent and Mercury Vapor Lamps. • **SOLA ELECTRIC CO., 4633 West 16th Street, Chicago 50, Illinois, Bishop 2-1414** • *NEW YORK 35: 103 E. 125th St., TRafalgar 6-6464* • *PHILADELPHIA: Commercial Trust Bldg., Rittenhouse 6-4988* • *BOSTON: 272 Centre Street, Newton 58, Mass., Bigelow 4-3354* • *CLEVELAND 15: 1836 Euclid Ave., PRospect 1-6400* • *KANSAS CITY 2, MO.: 406 W. 34th St., Jefferson 4382* • *LOS ANGELES 23: 3138 E. Olympic Blvd., ANgelus 9-9431* • *TORONTO 17, ONTARIO: 102 Laird Drive, Mayfair 4554* • *Representatives in Other Principal Cities*




# CERTIFIED CBM BALLASTS

*...give you more economical Fluorescent Lighting*

**because they are "Tailored to the Tube"**



Every type and size of fluorescent tube has its own specific electrical requirements. Thus, to get ideal performance and lighting economy, it is essential that the ballasts provide precisely the electrical needs of the tubes they operate.

**CERTIFIED CBM BALLASTS** are "Tailored to the Tube." Built to exacting specifications, then tested and checked by ETL, an independent agency, CERTIFIED CBM BALLASTS are a dependable assurance of both satisfactory and economical fluorescent lighting.

## Certified CBM Ballasts

**PROVIDE:**

**LONG BALLAST LIFE**
**FULL LIGHT OUTPUT**
**LONG LAMP LIFE**
**TROUBLE-FREE OPERATION**

all of which contribute to easier maintenance and fluorescent lighting economy.

Eight of the country's leading manufacturers of ballasts make CERTIFIED CBM BALLASTS. Participation in CBM is open to any manufacturer who wishes to qualify.

***Send for free booklet, "Why It Pays to Use CERTIFIED CBM BALLASTS in Fluorescent Lighting Fixtures"***

**CERTIFIED BALLAST MANUFACTURERS**

2116 KEITH BLDG., CLEVELAND 15, OHIO

# AIR CONDITIONED!

*it's cool inside*

# GUTH

# PEERLITE

Trademark

Permits flexible pattern planning. You can form any design you wish. For 2, 3, or 4 lamps—4′ or 8′ long.

## more cooling less cleaning

Wide open on top and bottom for brisk air-circulation

Cool lamps last longer.
Clean lamps stay brighter.
Clean fixtures give more light!

RESULT: greater efficiency
less maintenance
long lasting beauty

*U. S. & Can. Pats. Pend
Trademark registered

Guth

**THE EDWIN F. GUTH COMPANY** ST. LOUIS 3, MO.

Leaders in Lighting Since 1902